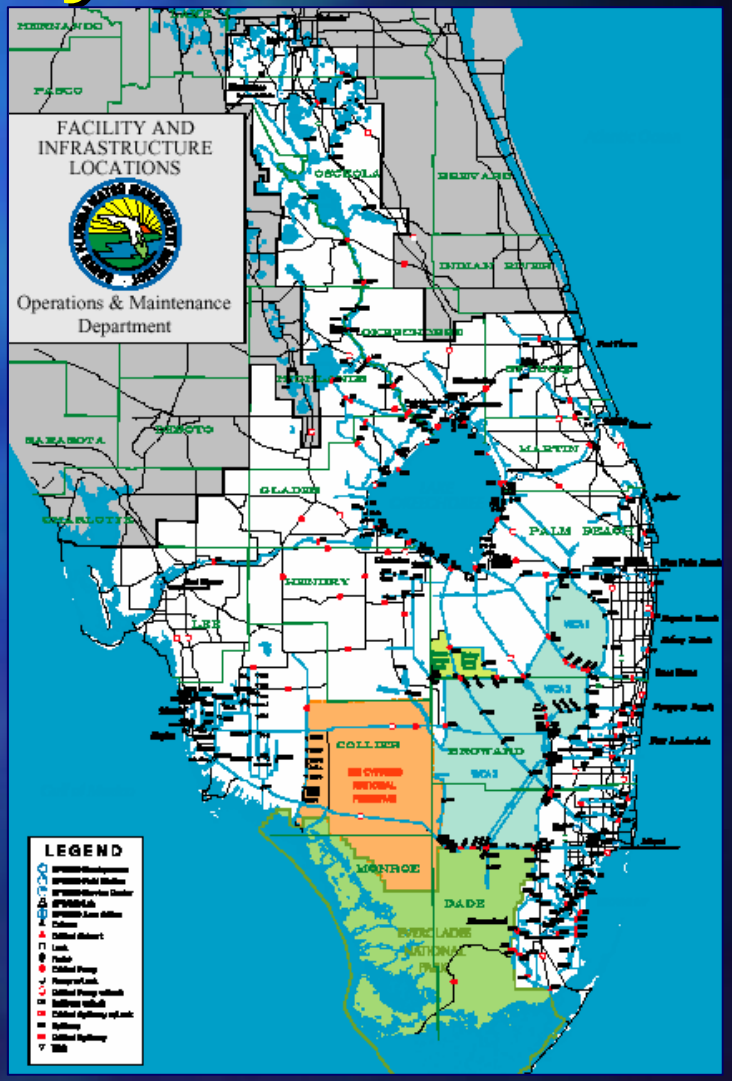
The Central and Southern Florida Project

Operations Control, Engineering & Vegetation Management Department

South Florida Water Management District

Water Resource System

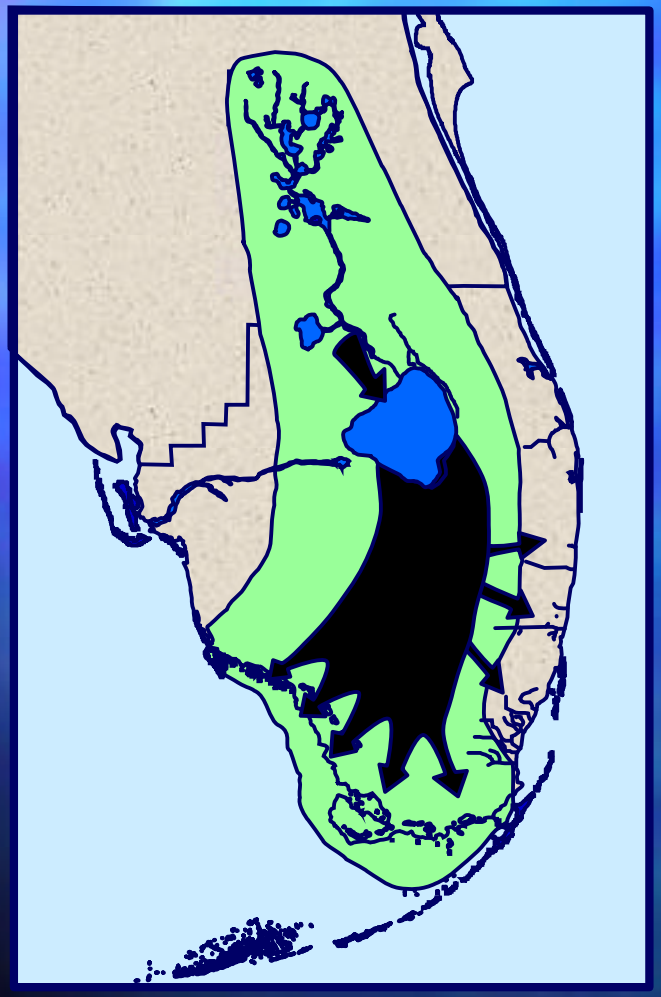
- *"One of the world's largest and most complex water resource management systems"*
- Upper Chain of Lakes / Kissimmee River
- Lake Okeechobee
- Caloosahatchee River
- St. Lucie Canal
- Water Conservation Areas
- Everglades National Park / Florida Bay



History of the C&SF System

History of the C&SF System

The "Original" Everglades Ecosystem "River of Grass"



- Water connected the system, from top to bottom
- Diverse mosaic of landscapes and seascapes
- No natural connection between Lake Okeechobee and the Caloosahatchee or St. Lucie estuaries

PROGRESSIVE FLORIDA.

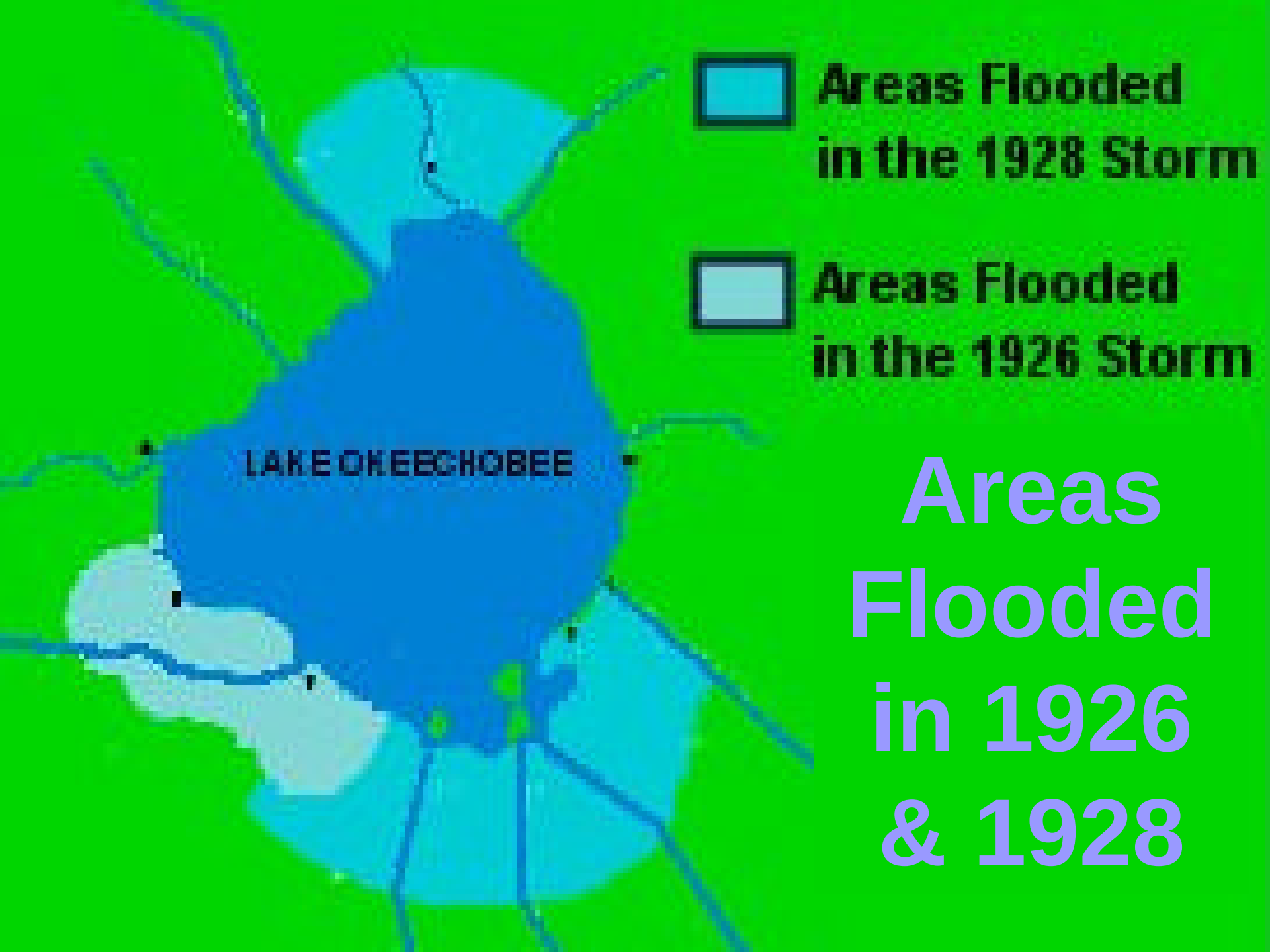
RECLAIMING THE GREAT EVERGLADES

CALOOSAHATCHEE RIVER DISTRICT, NEAR FORT MYERS, FLA

1928 Okeechobee Flood

- San Felipe Hurricane
  - Killed 312 in Puerto Rico on Sept 13
- The storm hit Florida about 6 p.m. Sept. 16 with 125 mph winds. For two hours it ripped apart boats and battered homes. But most residents had taken cover, and deaths were few.
- Forty miles west, rain filled Lake Okeechobee to the brim, then a wind from the north began pushing tons of lake water to the south. The dikes crumbled, and water rushed onto the swampy farmland. Homes and people were swept away. 1,836 people perished.

- *Courtesy of the Sun Sentinel & Palm Beach County Historical Society*


Areas Flooded in the 1928 Storm
Areas Flooded in the 1926 Storm
LAKE OKEECHOBEE
Areas Flooded in 1926 & 1928

1926 AND 1928

DEVASTATING HURRICANES

... LOSS OF 2,500 LIVES

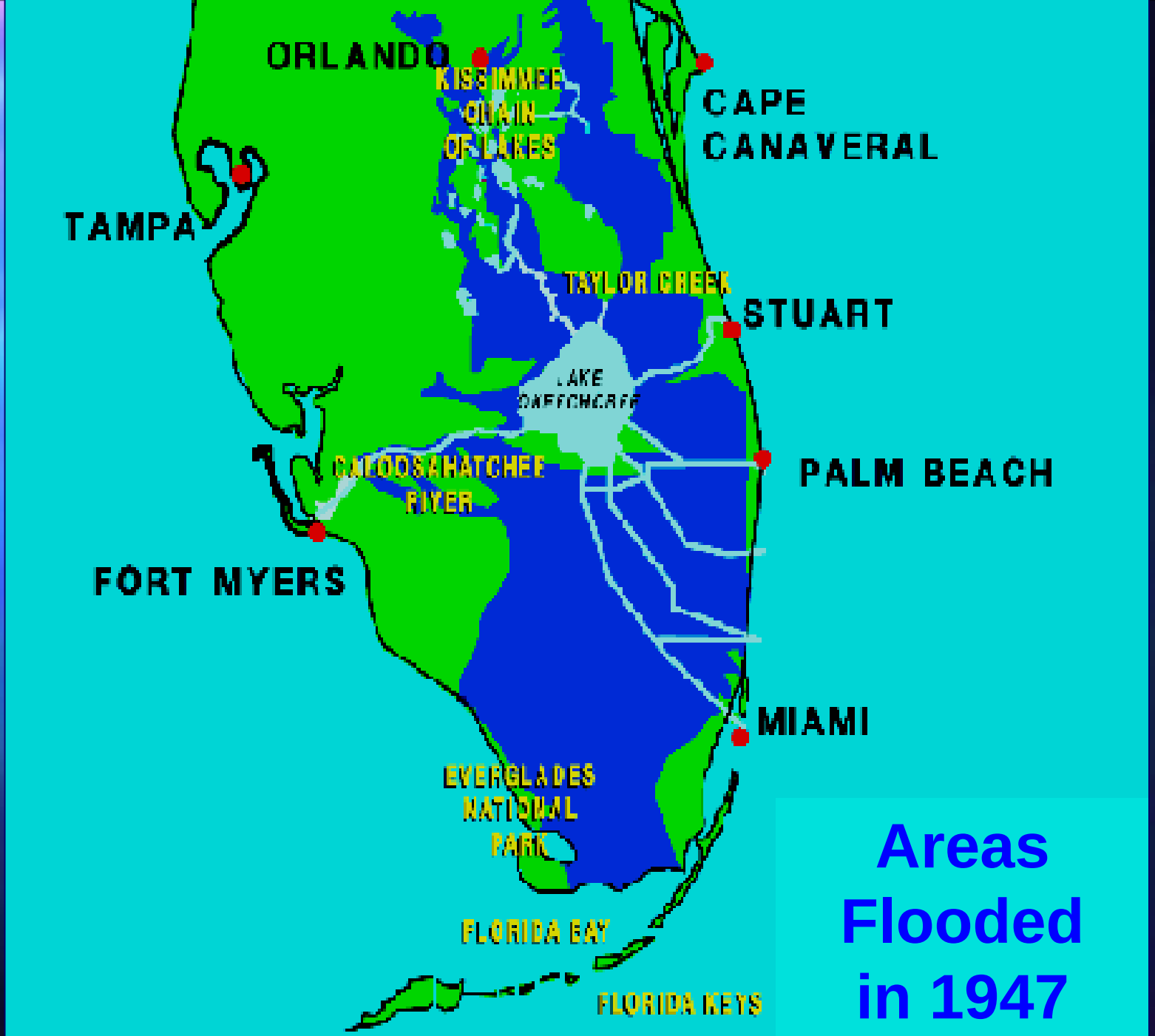
HOOVER DIKE AUTHORIZED 1930

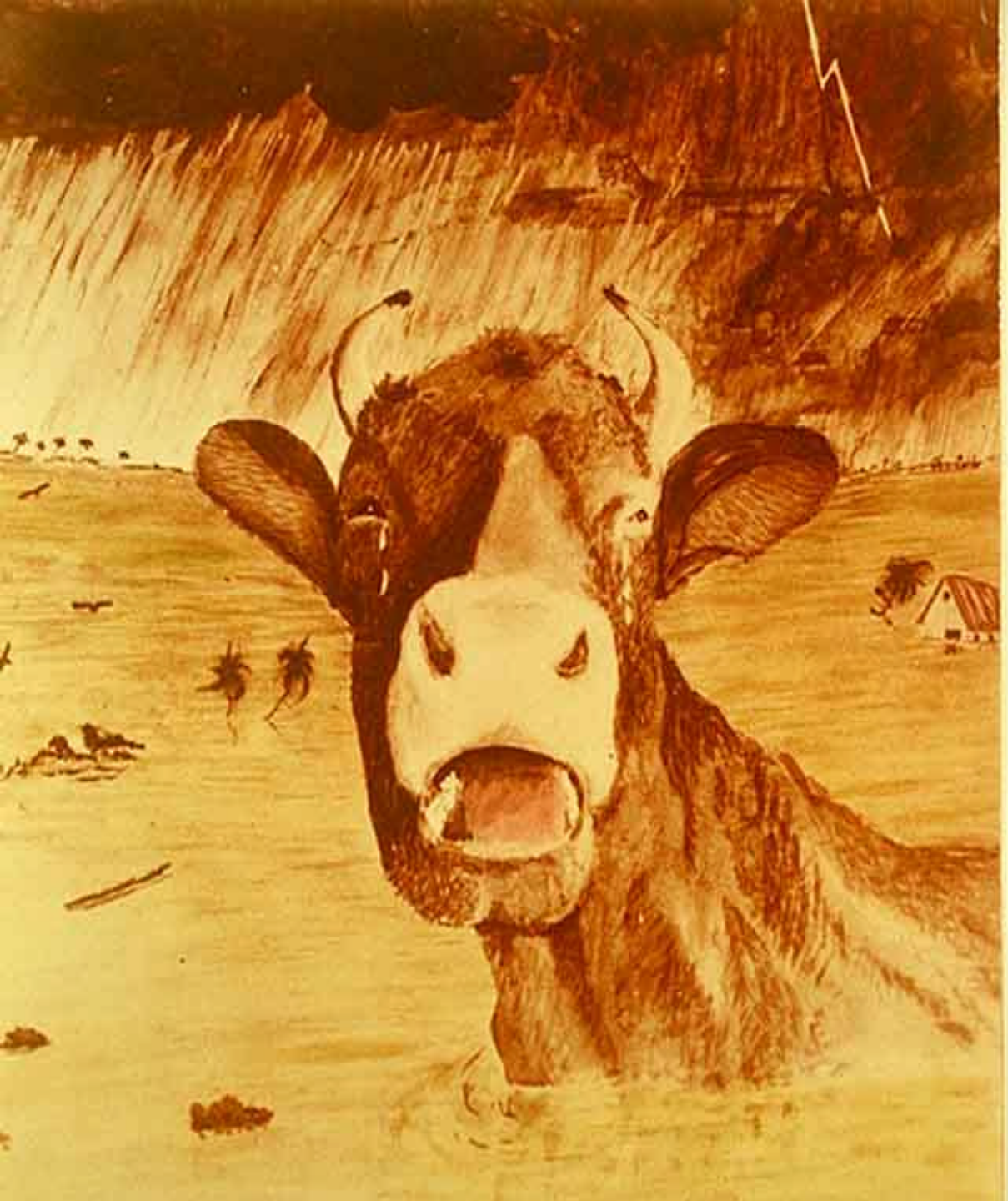
... COMPLETED 1937

1947 Flood

- Andrews Avenue is flooded after a hurricane hit Fort Lauderdale in 1947. Two hurricanes passed over Broward County that year.
- At one point, 12 inches of rain fell in a 30 minute period.
- (Fort Lauderdale Historical Society) Sep. 18, 1947

- *Courtesey of the Sun Sentinel & Fort Lauderdale Historical Society*


ORLANDO
KISSIMMEE
CHAIN
OF LAKES
CAPE
CANAVERAL
TAMPA
TAYLOR CREEK
STUART
LAKE
OKEECHOBEE
CALOOSAHATCHEE
RIVER
PALM BEACH
FORT MYERS
MIAMI
EVERGLADES
NATIONAL
PARK
FLORIDA BAY
FLORIDA KEYS
Areas
Flooded
in 1947



TENTATIVE
REPORT
OF

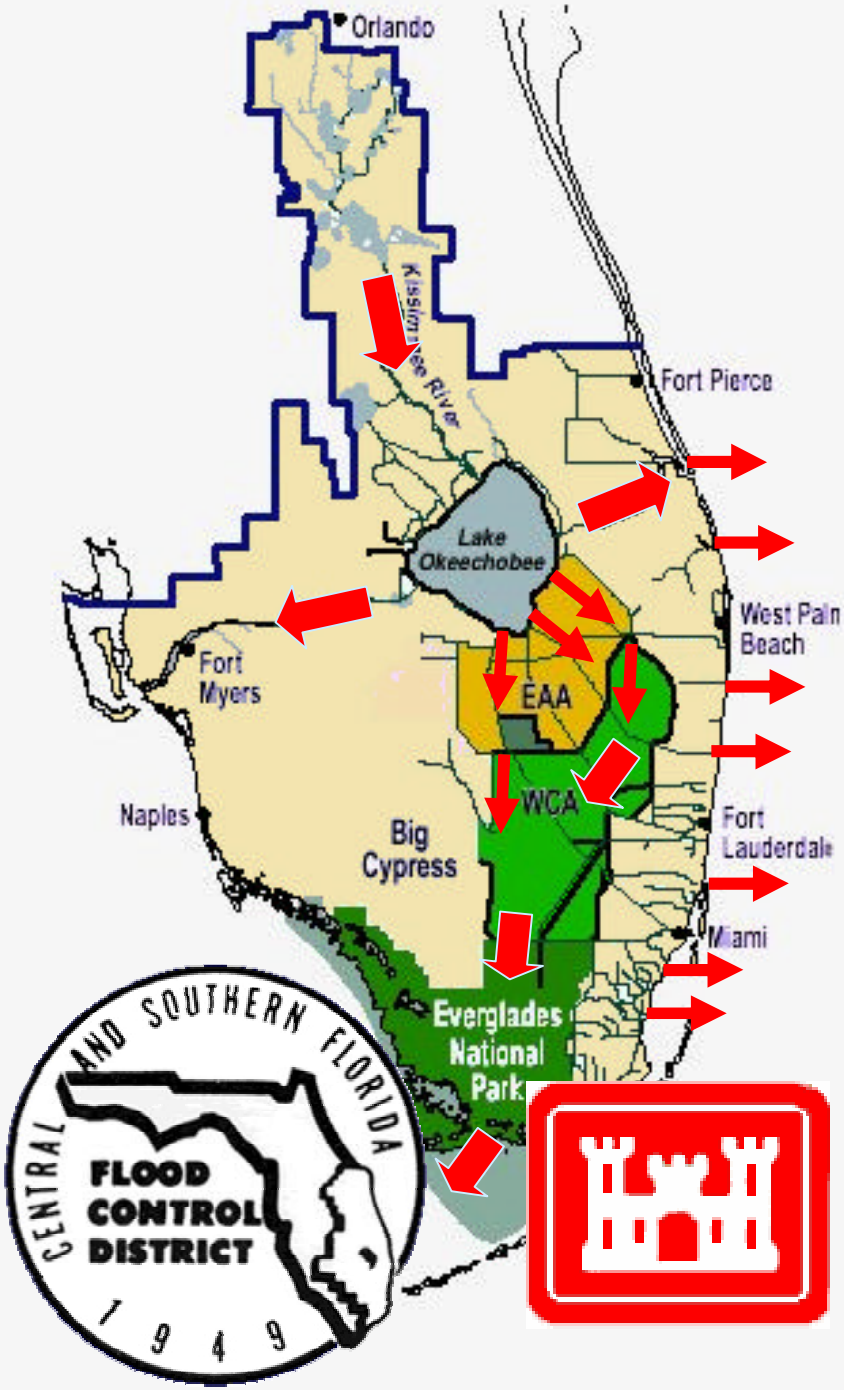
FLOOD DAMAGE

FLORIDA
EVERGLADES
DRAINAGE
DISTRICT

1947

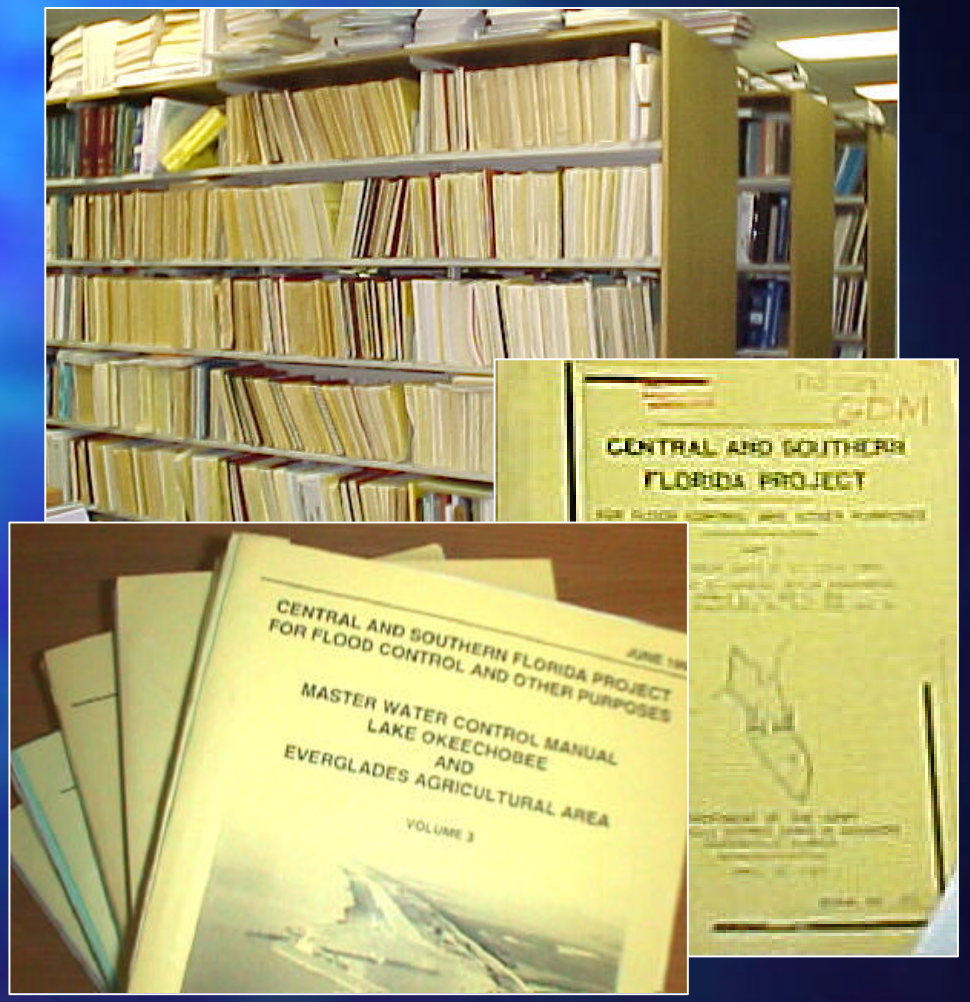
The Central and Southern Florida Project

- "Central and Southern Florida Project for Flood Control and Other Purposes"
  - Initially authorized in 1948
  - Constructed between 1950's and 1970's
- Operated in accordance with USACE criteria
  - USACE
  - SFWMD



Basis of Design and Operation

- USACE Design Memorandums
  - Engineering basis of design
  - Developed in 1950s, 60s & 70s
- USACE Master Water Control Manuals
  - Define specific operational criteria
  - Based on Design Memorandums

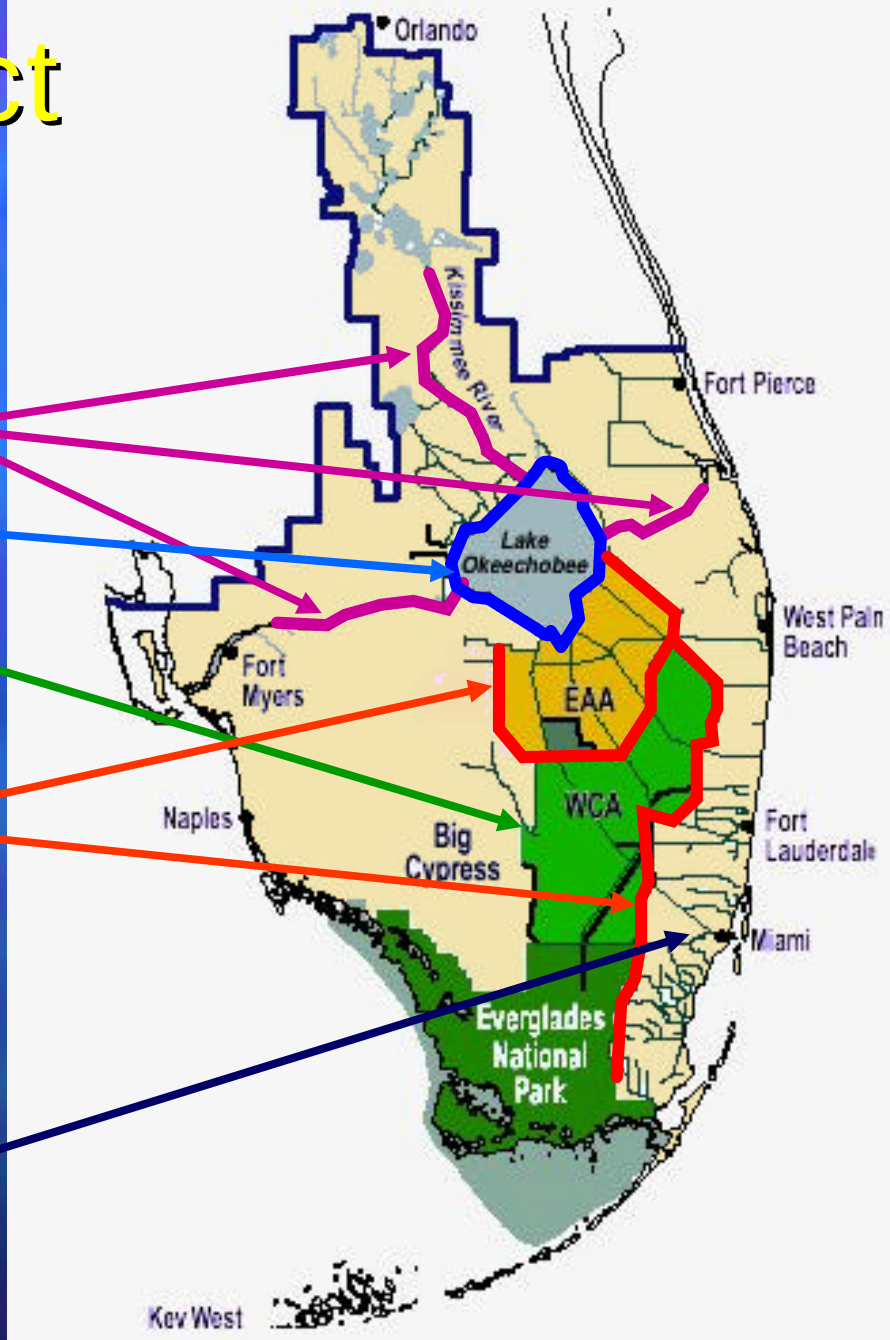


The “Project Purpose”

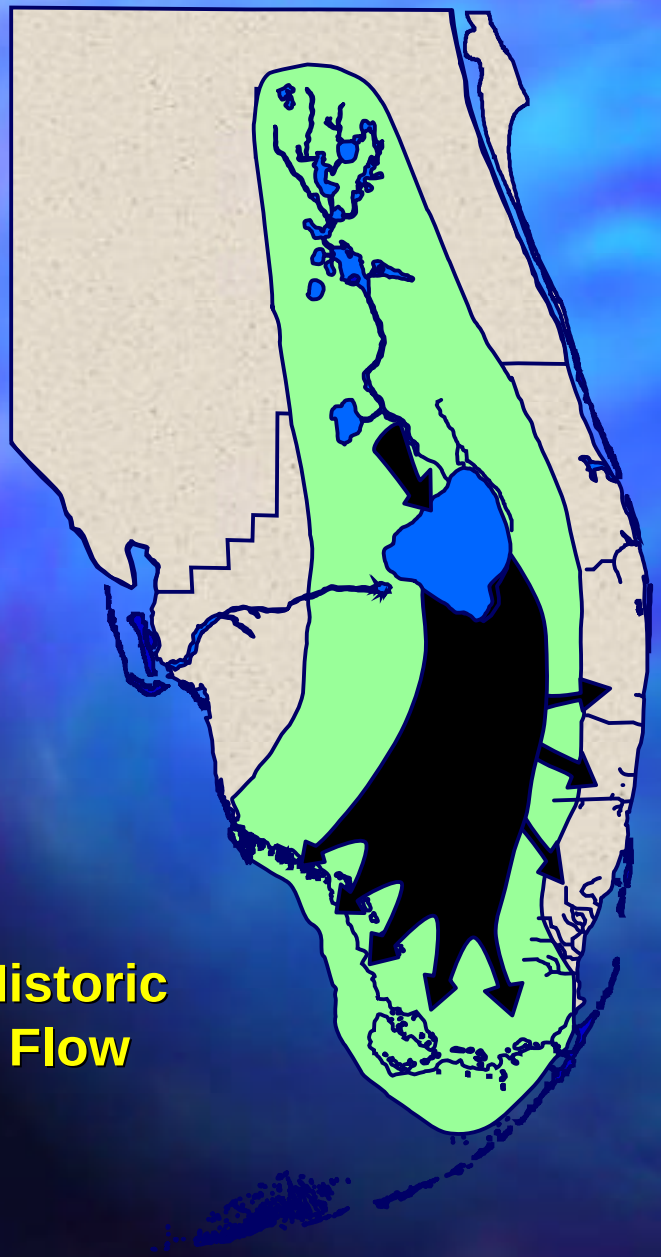
- Flood Control
- Water Supply
  - Agriculture
  - Urban
  - Everglades National Park
  - Saltwater Intrusion
- Navigation
- Protection of “fish and wildlife”

Major C&SF Project Components

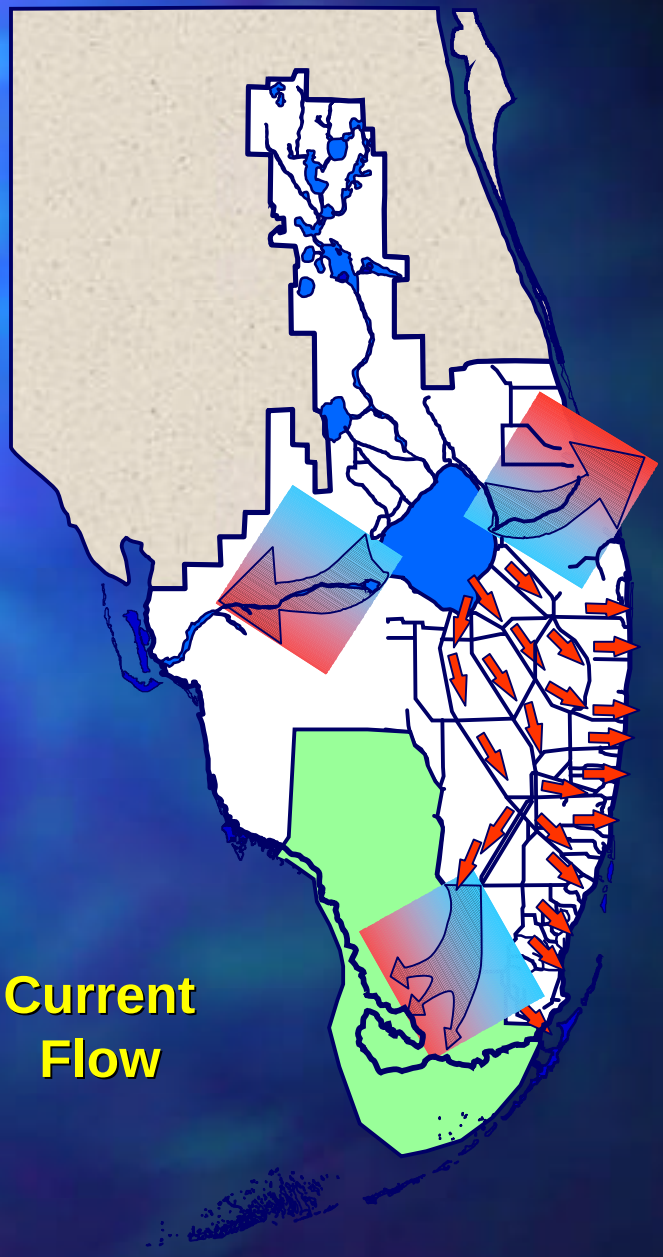
- River Channelization
- Herbert Hoover Dike
- Water Conservation Areas
- Protective Levees
  - Everglades Agricultural Area
  - Lower East Coast
- Drainage Network
  - Salinity Structures



Water Resource Modifications



Historic Flow



Current Flow

Water Management System Components

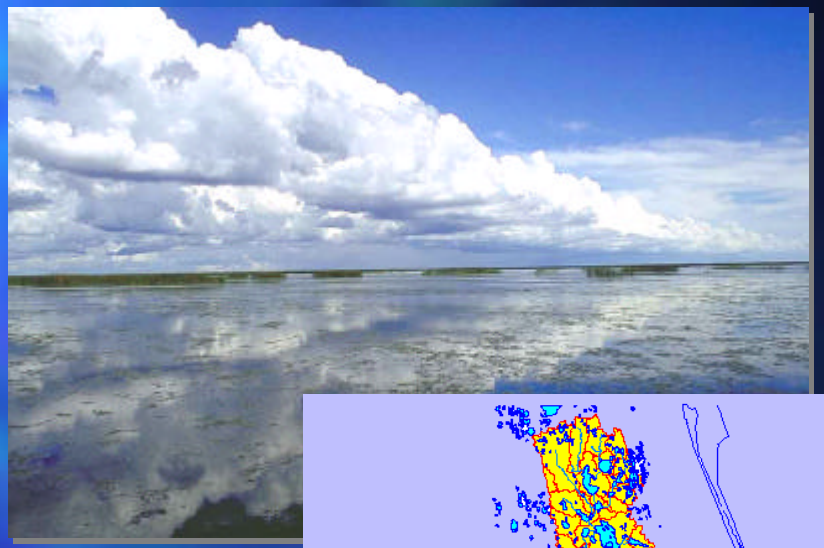
- ~1,800 miles of canals and levees
- 160 major drainage basins
- ~2,000 water control structures
  - 300 major structures
    - 170 critical (remote automation)
    - 130 manual operations
      - 25 structures operated by USACE
        - 12 major structures
- 39 pump stations
  - 6 under remote automation/control

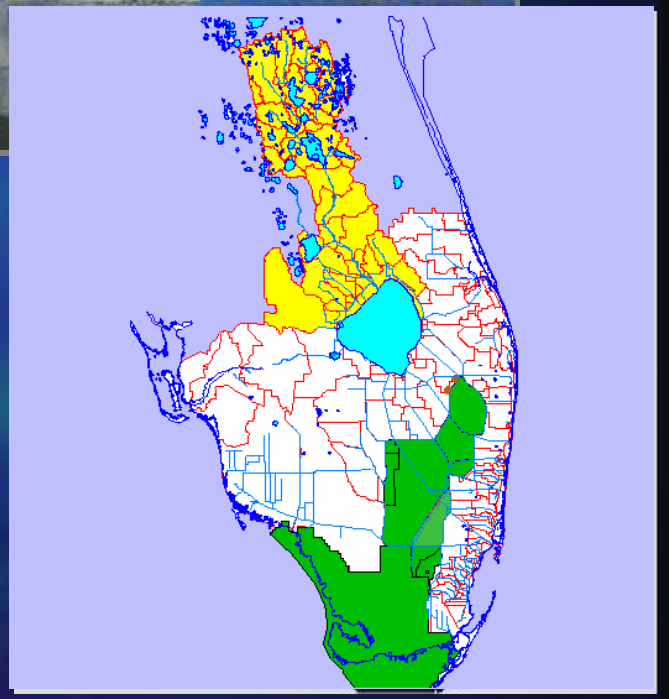
Regional Operations


Lake Okeechobee

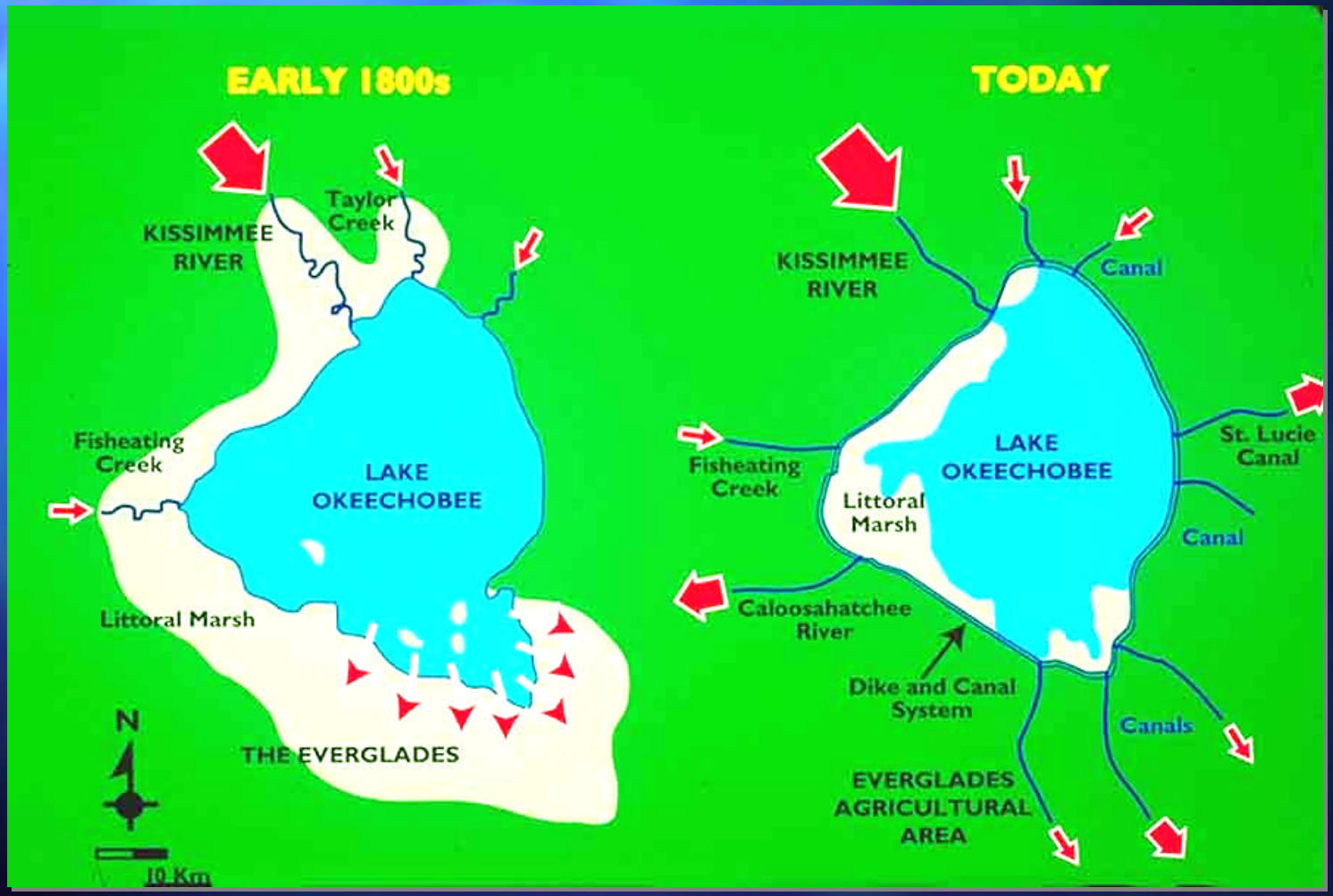
System Limitations
Lake Okeechobee

- Lake Okeechobee covers over 730 square miles, with a contributing basin of over 5,000 square miles
- Water levels driven largely by climatic conditions
- Serves multiple purposes…
  - Water Supply Storage
  - Flood Protection
  - Environmental



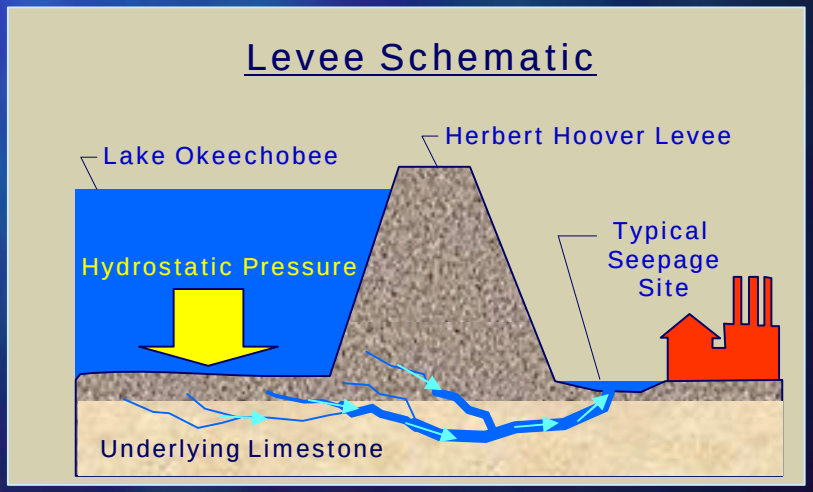


Natural vs. Altered Conditions

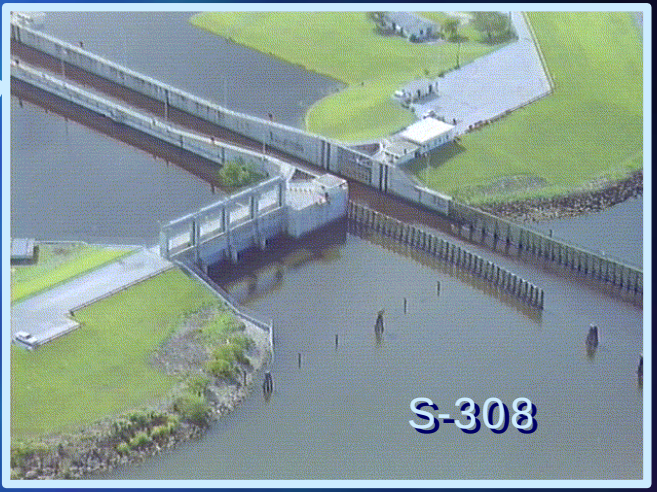


Herbert Hoover Levee Issues

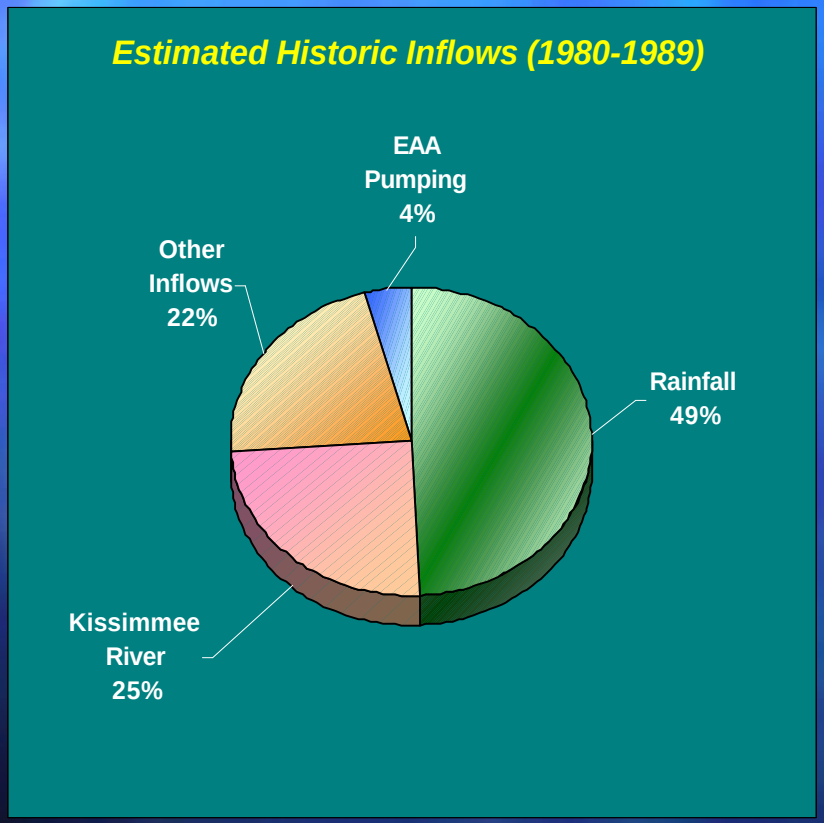
- The levee protects communities surrounding the lake from storm surge flooding
- High stages place pressure on the levee which could effect stability

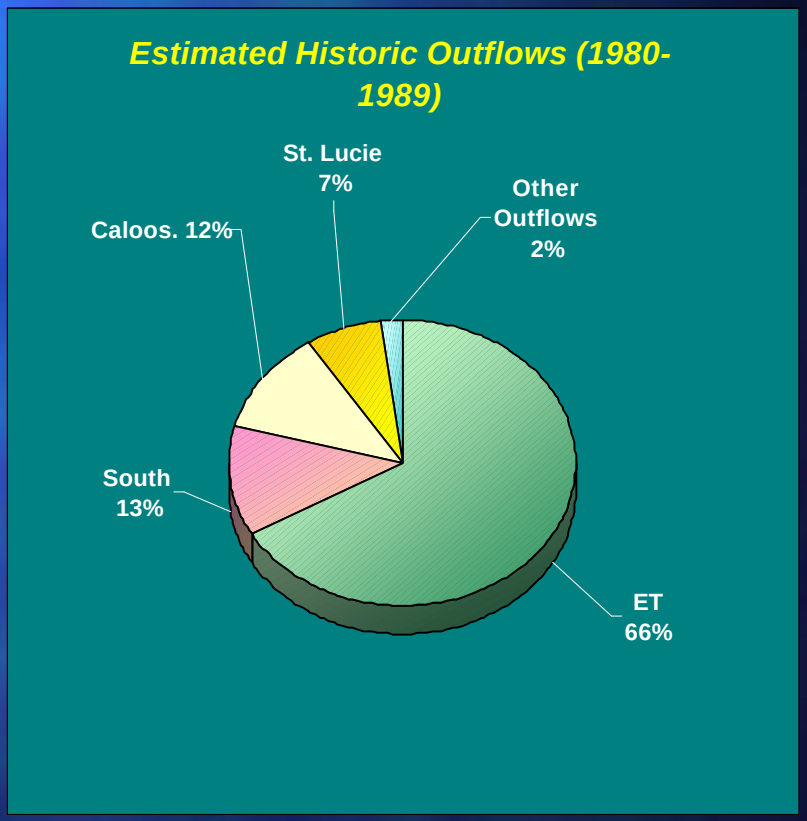


Lake Okeechobee
Major Water Control Structures



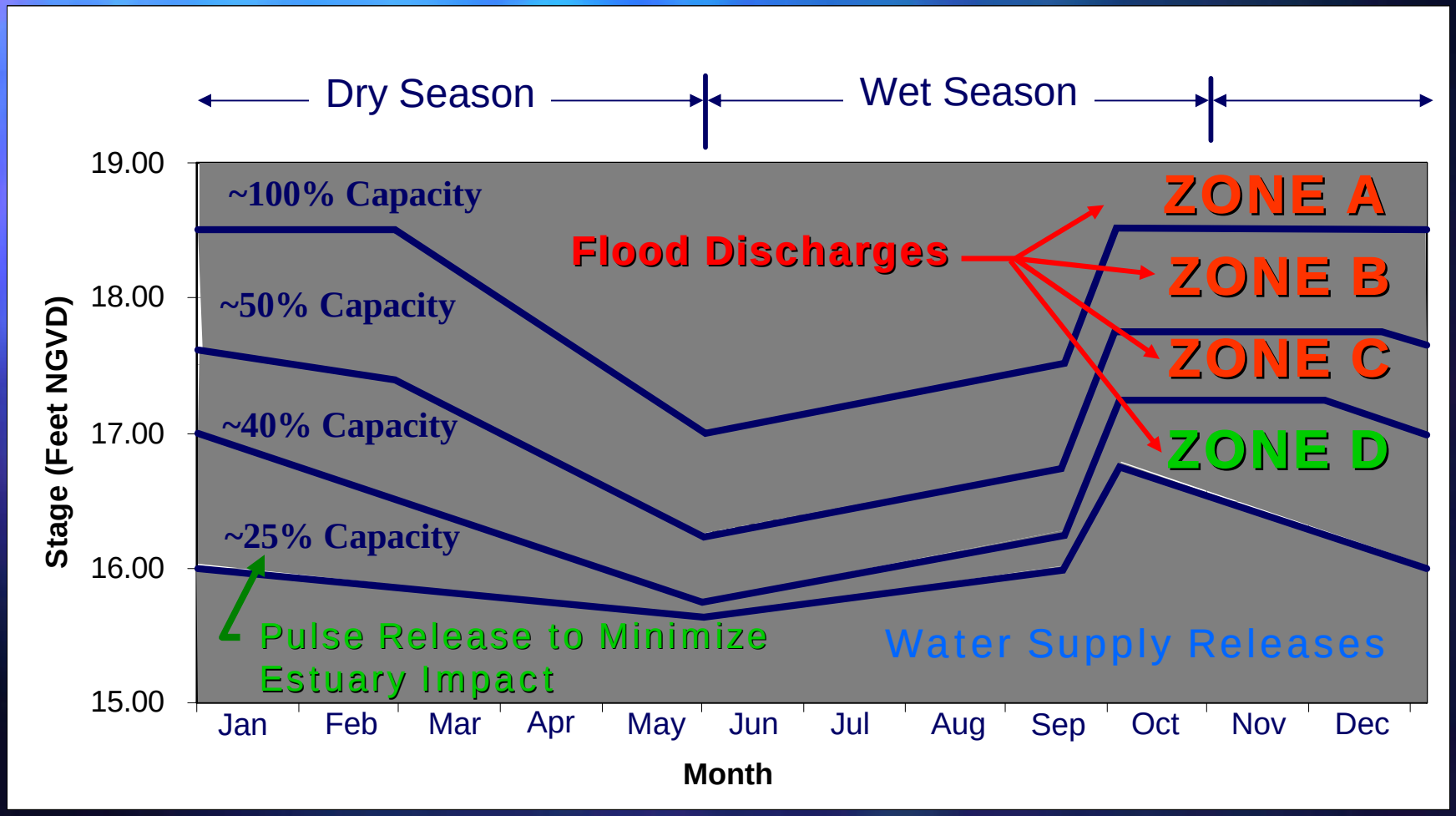
Comparison of Historical Average Flows



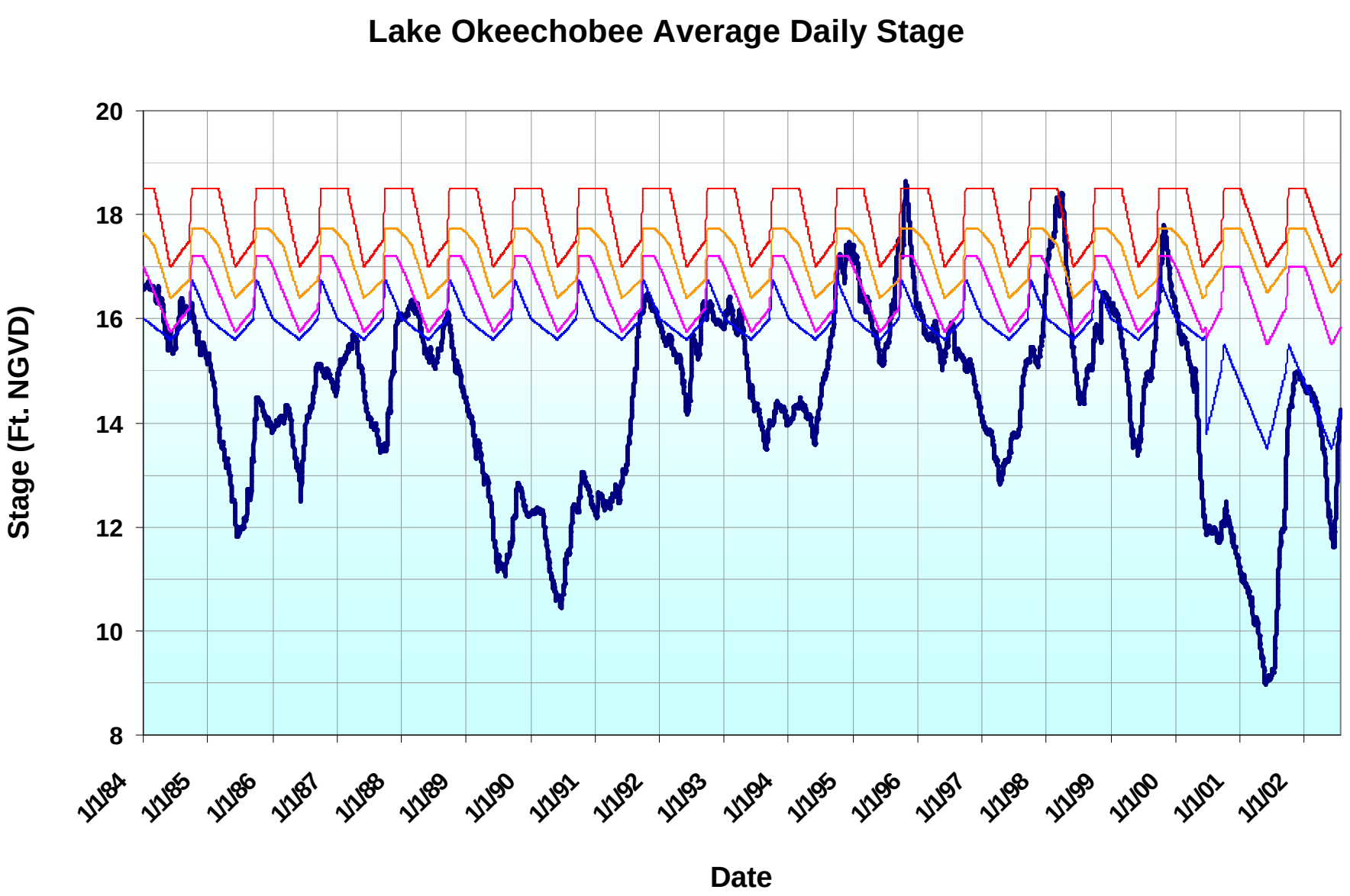


Lake Okeechobee Regulation Schedule

US Army Corps of Engineers

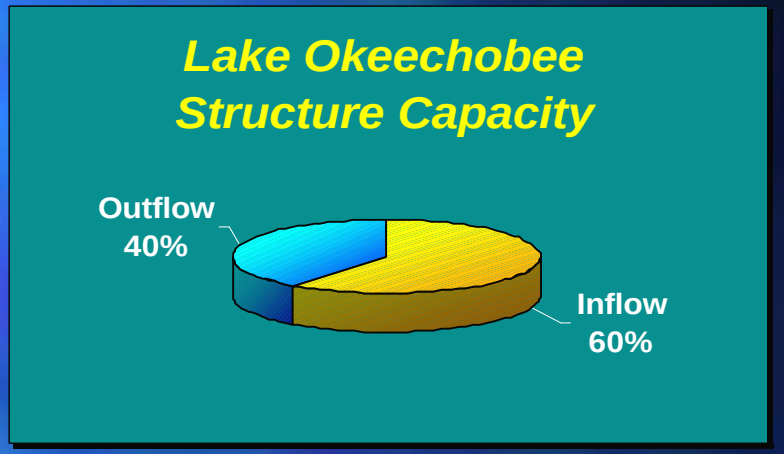


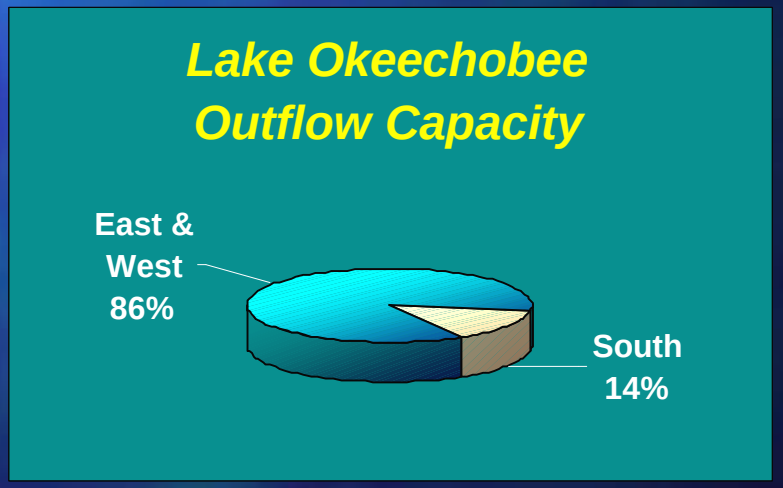
Lake Okeechobee Historical Stages



Lake Okeechobee Design Discharge Capacities

- Inflows to the lake frequently exceed total outflow capacity
- Outflow capacity to St. Lucie & Caloosahatchee far exceeds capacity to Conservation Areas



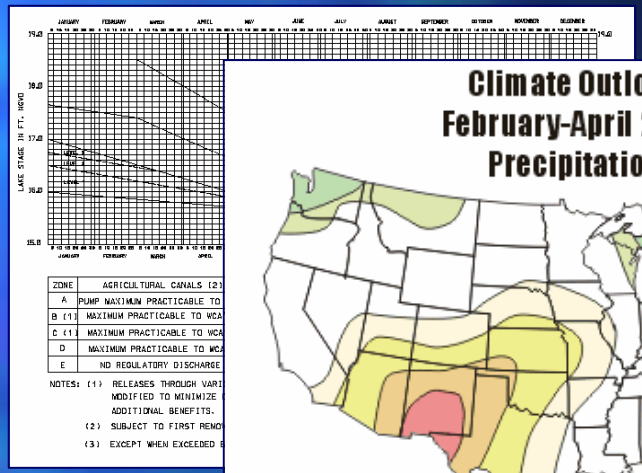


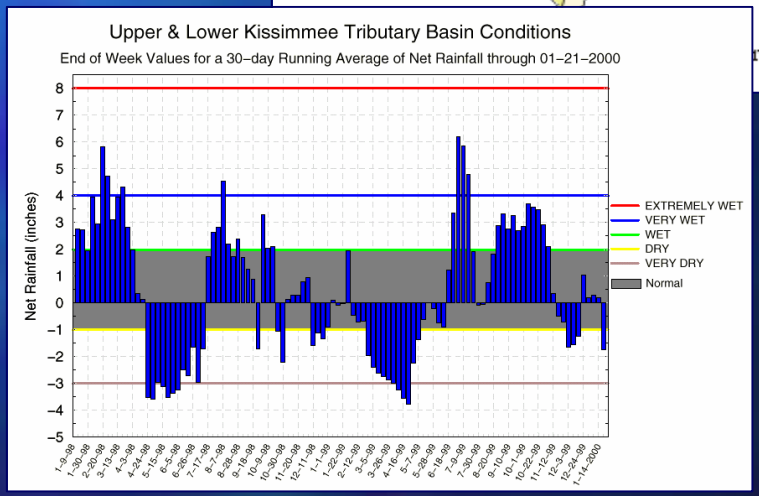
Lake Okeechobee Environmental Issues

- Historically, lake vegetation has been damaged in wet years by high lake stages
- Environmental scientists and local advocates encourage management of lower lake stages
  - Encourages growth of vegetation and prevented loss of the fishery
  - Provides opportunities to remove undesirable vegetation
- Managing at lower stages requires more discharge to the estuaries
- Maintains less water in the lake to meet dry season regional water demands

Regulation Schedule Development and Evaluation

- Numerous schedules have been put into place since the 1940's
  - Earlier schedules focused on flood protection
  - Later schedules balanced water supply and estuary impacts (RUN25)
- WSE Schedule
  - Continued to improve consideration for environmental objectives
    - Lake littoral zone
    - Estuaries

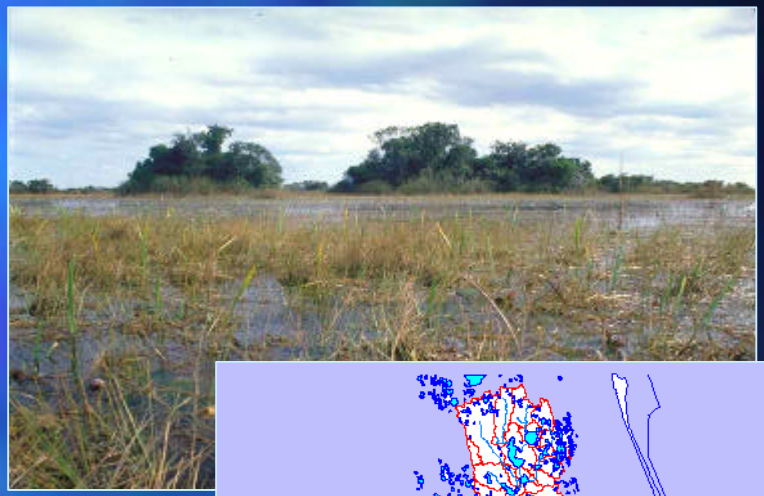


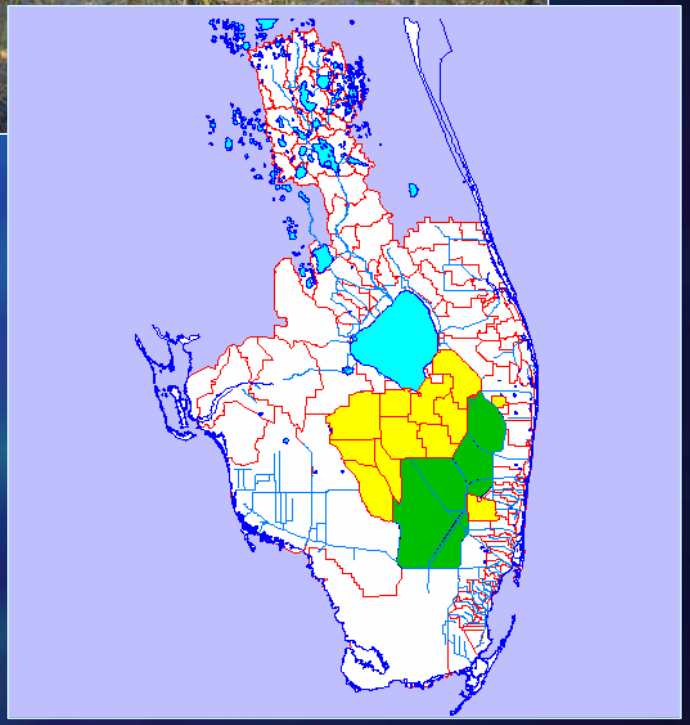


Water Conservation Areas & Everglades National Park

System Limitations
Water Conservation Areas

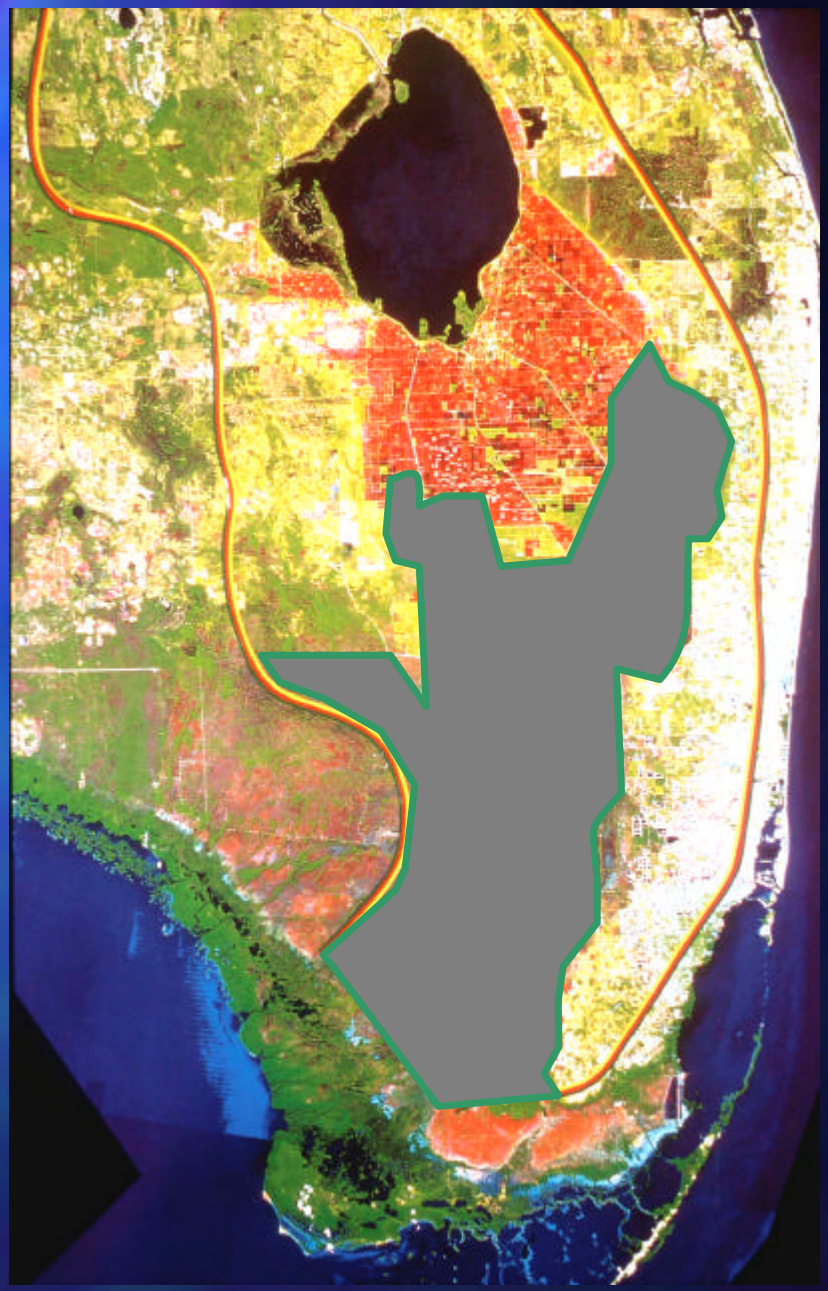
- Water Conservation Areas cover about 1,360 square miles with a contributing basin of over 1,720 square miles
- Lake releases are made to the WCAs if there is minimal risk of impact





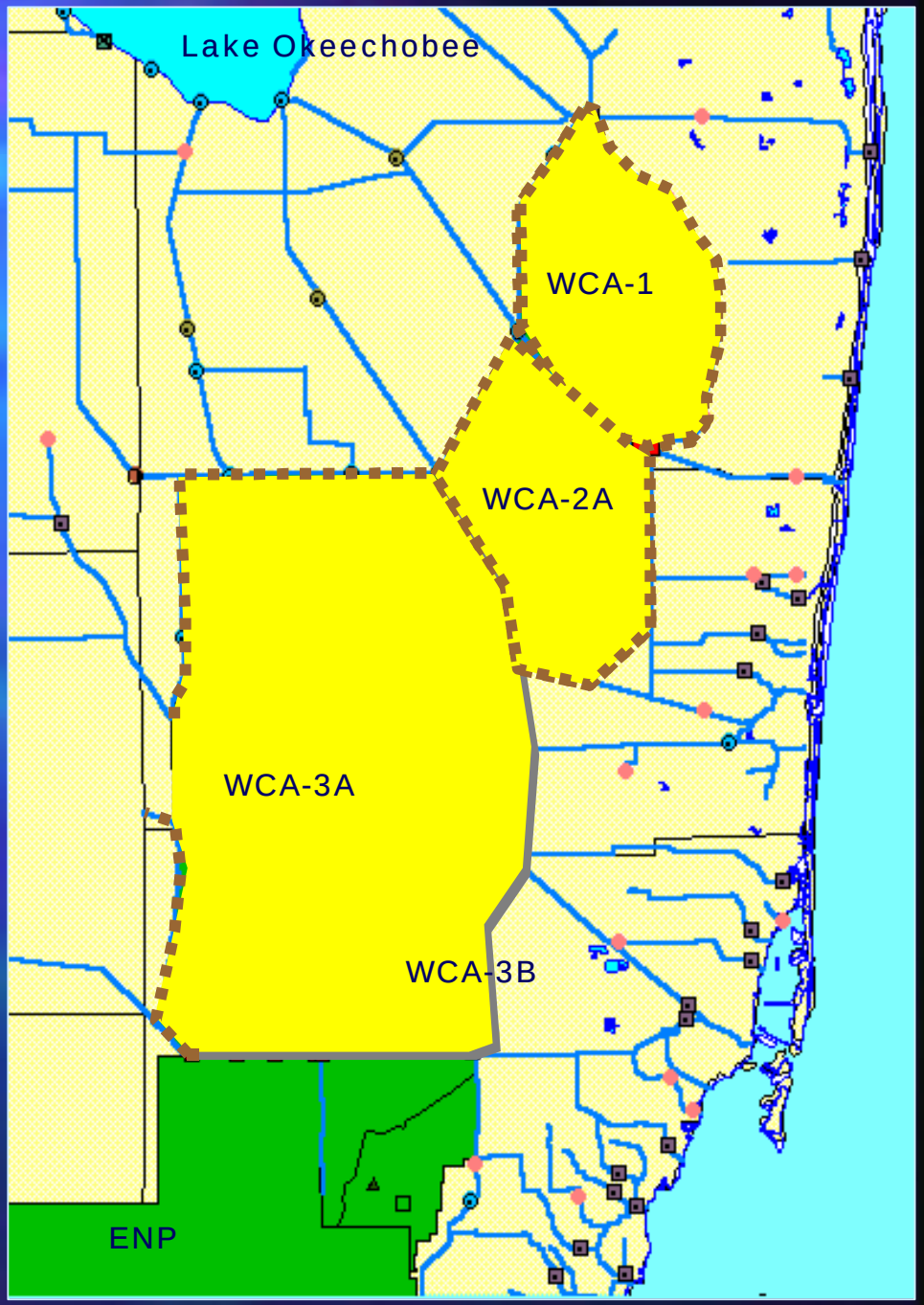
Everglades: Natural vs Altered Conditions

- Too much / too little water for the Everglades/south Florida ecosystem
- Degradation of water quality
- Repetitive water shortages and salt water intrusion
- 1.7 billion gallons of water a day wasted to tide
- Significant loss of Everglades habitat



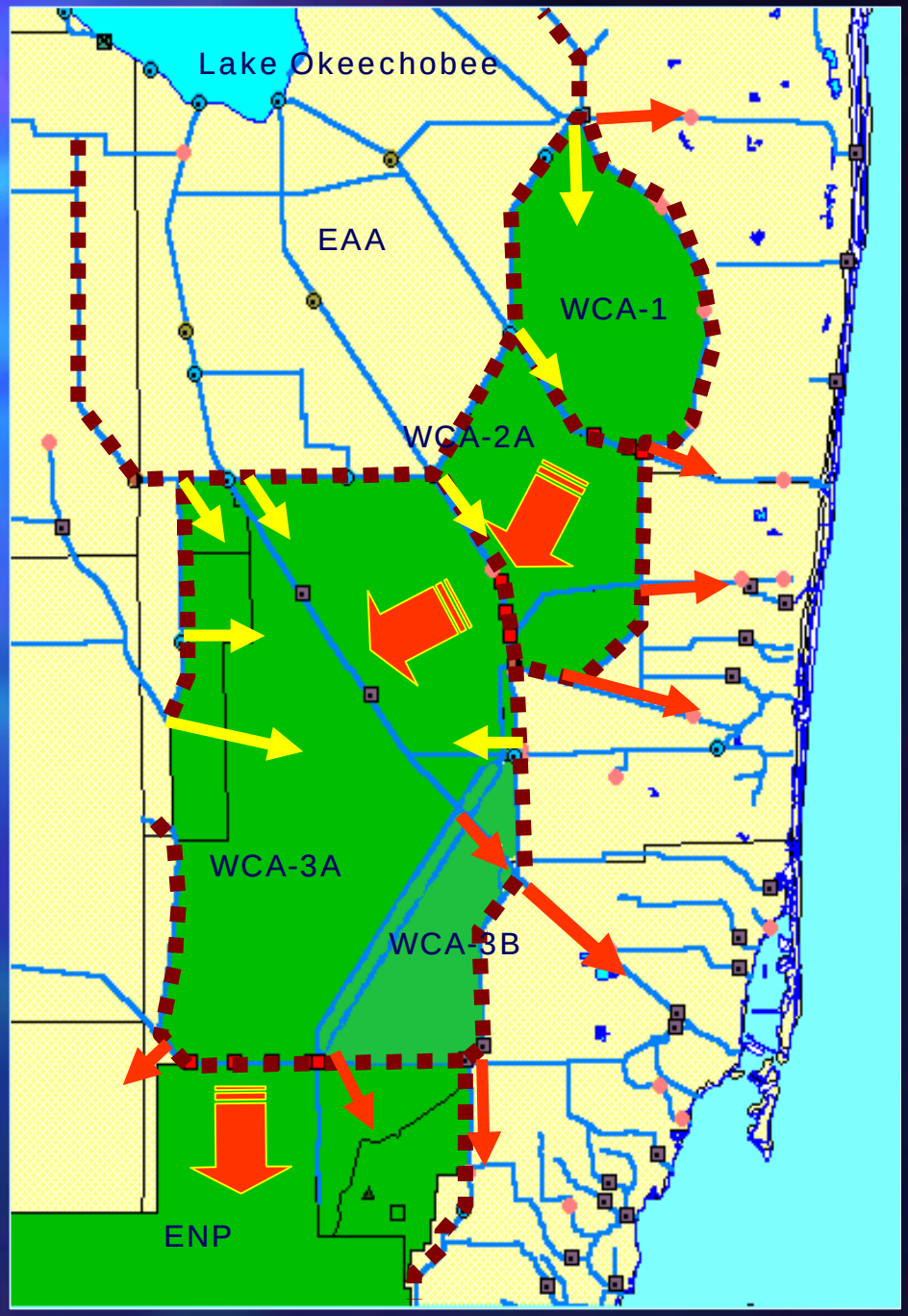
Water Conservation Areas

- Impounded remnant Everglades
  - Focused to “conserve” regional water
- Three Major WCAs
  - WCA 1,2 & 3
- Two Minor WCAs
  - WCA 2A & 3B

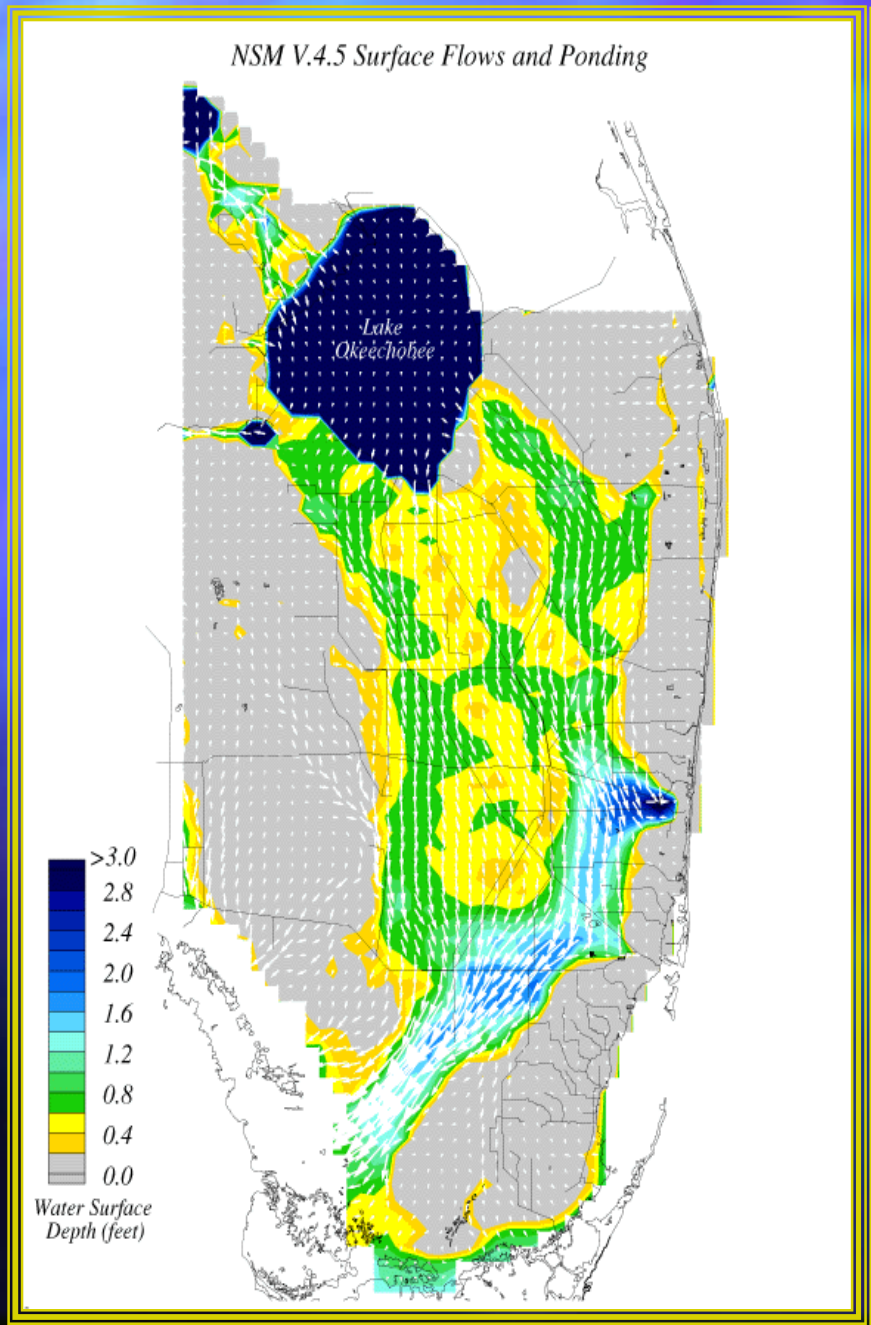


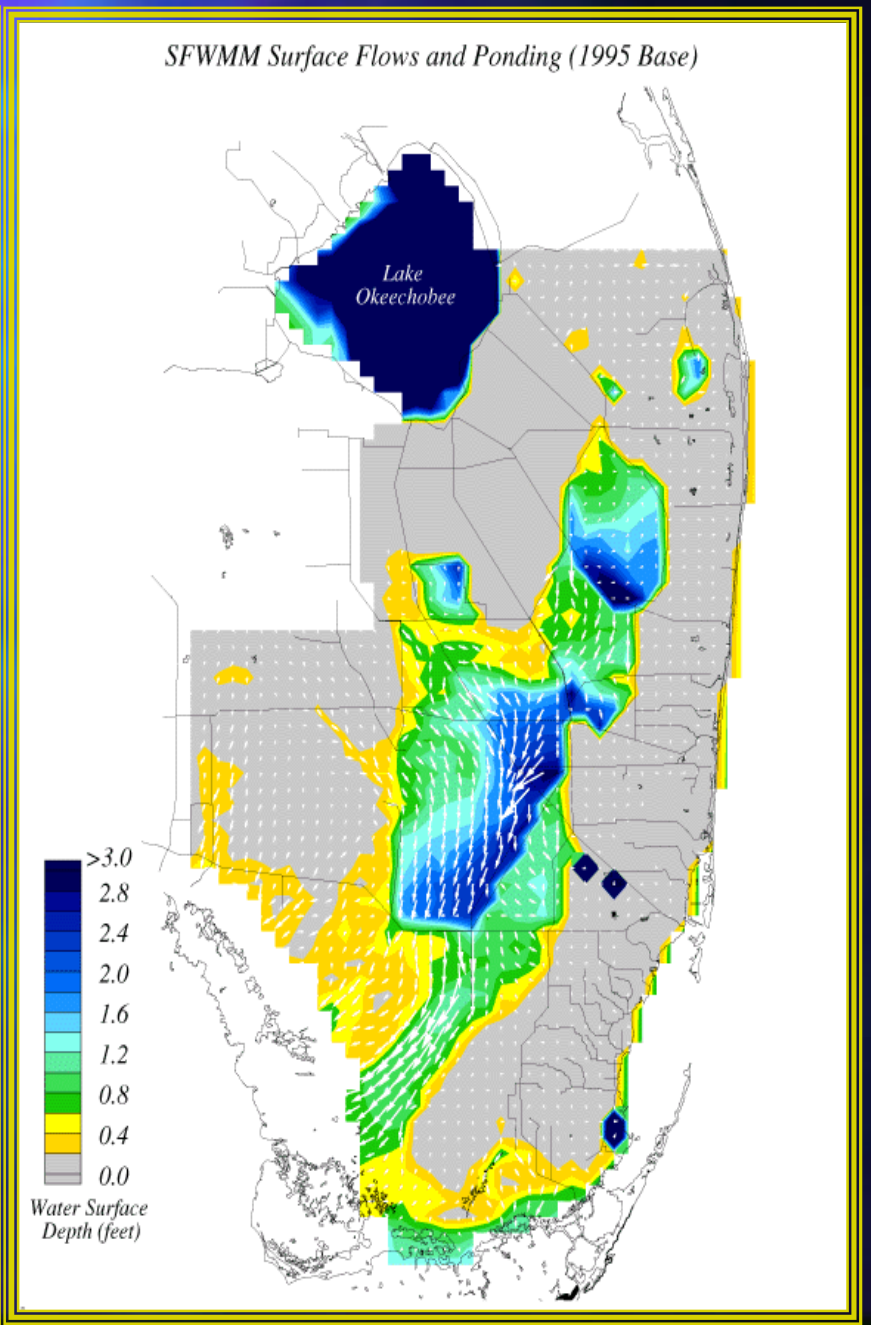
Everglades Protection Area Flow Patterns

- Levees impounded the Water Conservation Areas
  - Primary inflow sources
    - Flood Control (pumped)
    - Lake Okeechobee
- Major structures move excess water south
  - Smaller structures can discharge some excess water to the ocean
    - Provide water supply to Lower East Coast

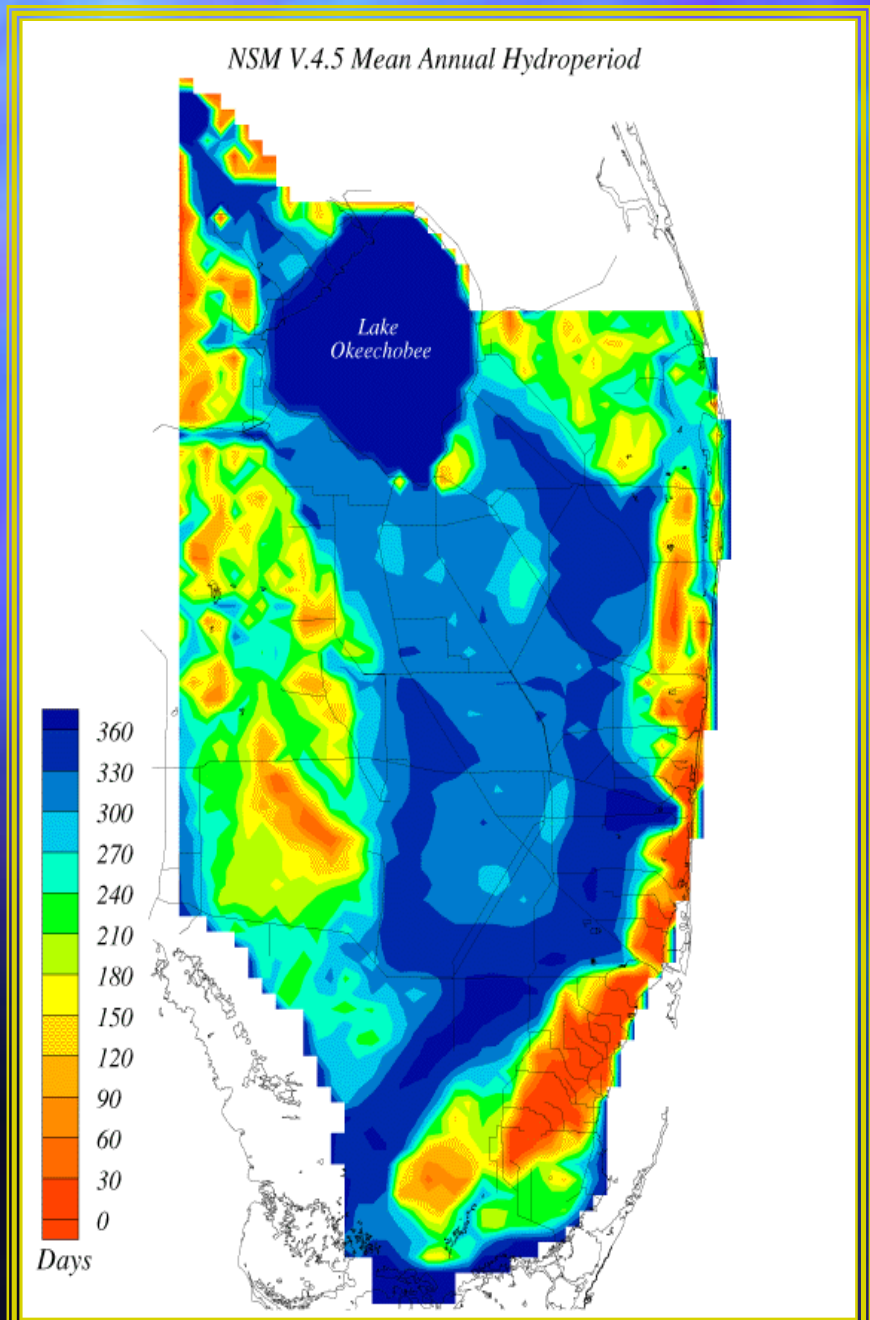


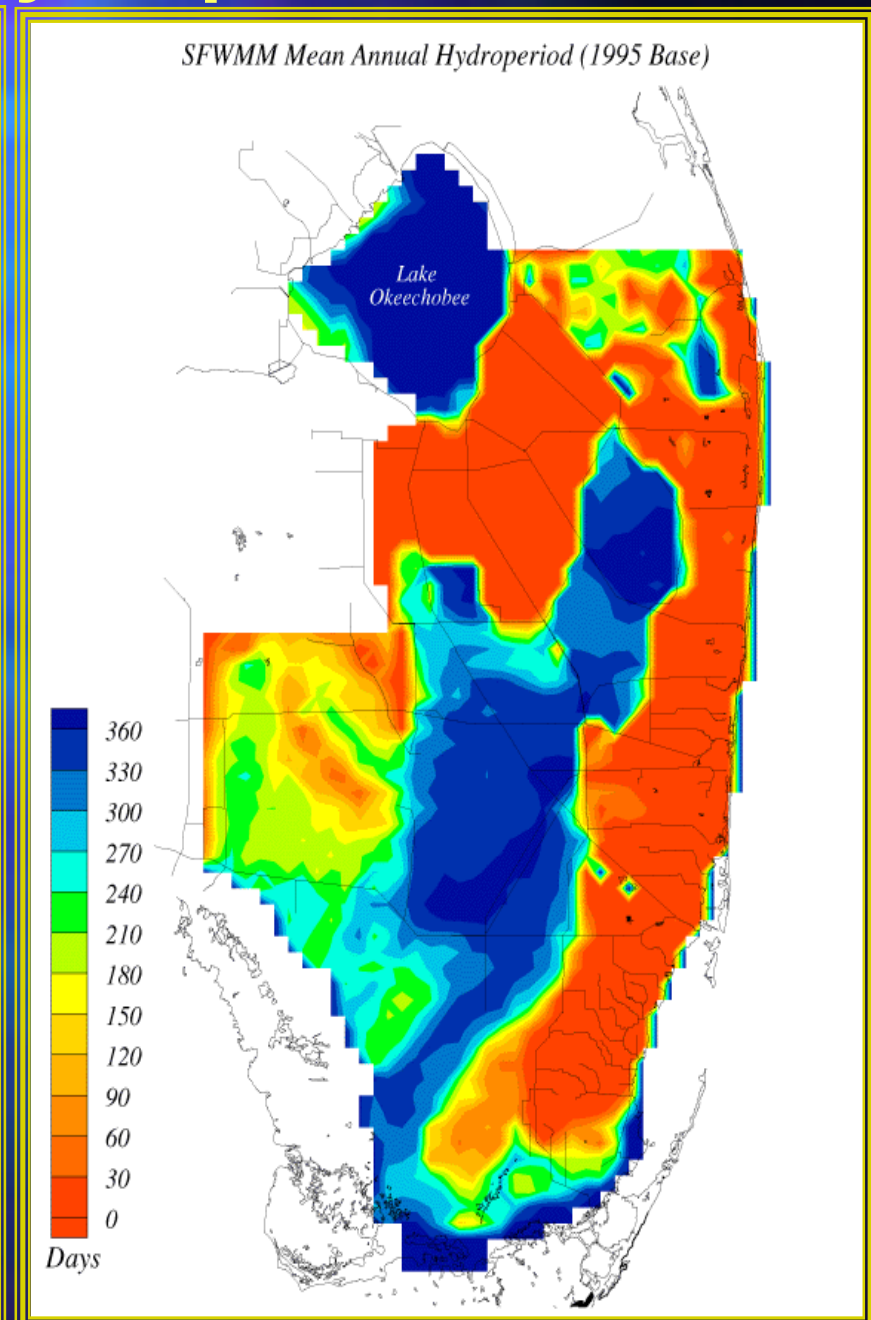
Natural vs. Altered Ponding Depth Patterns

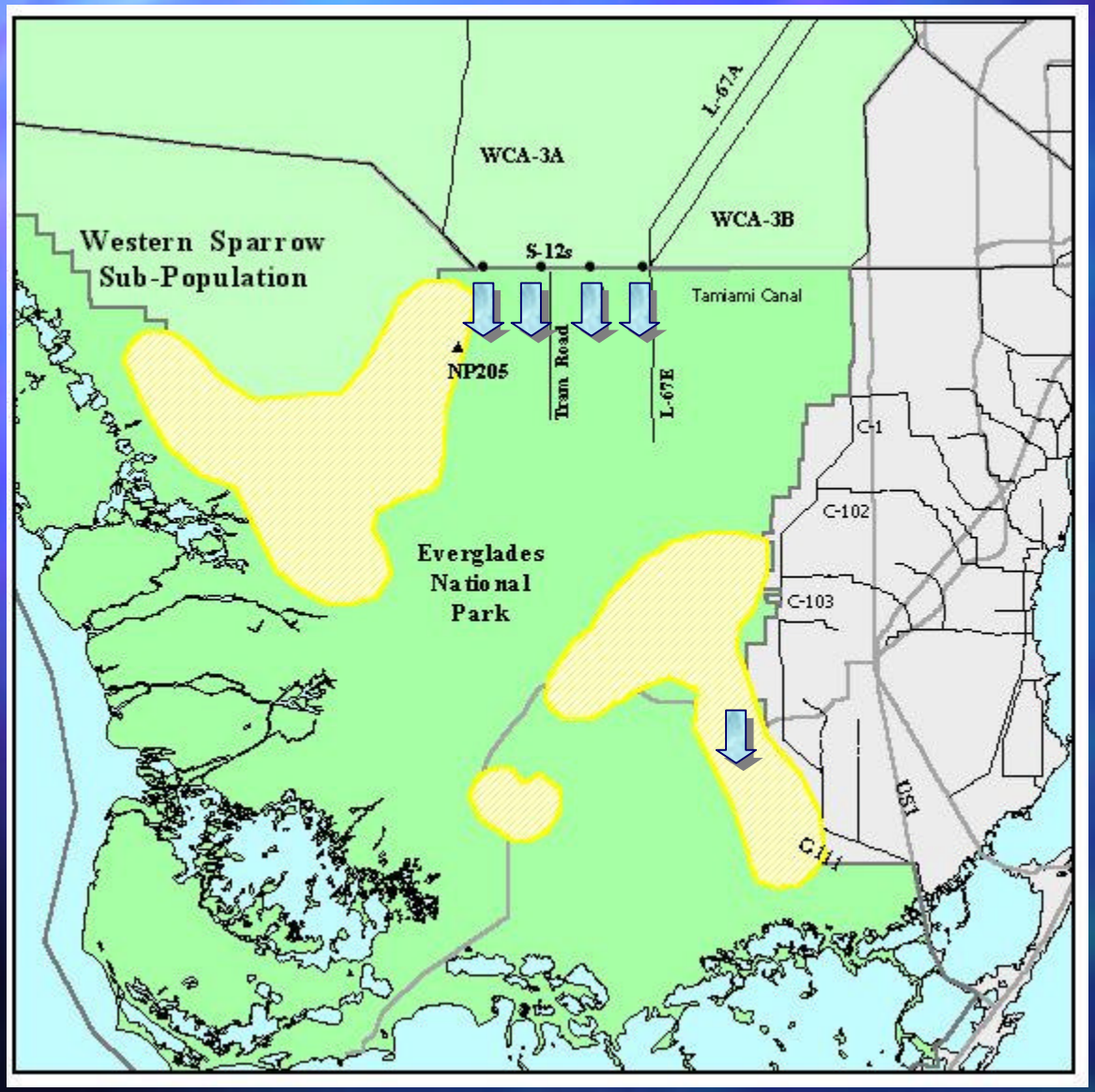




Natural vs. Altered Hydroperiod Patterns







Southern Everglades

Environmental Issues

Cape Sable Sparrow

Everglades Kite

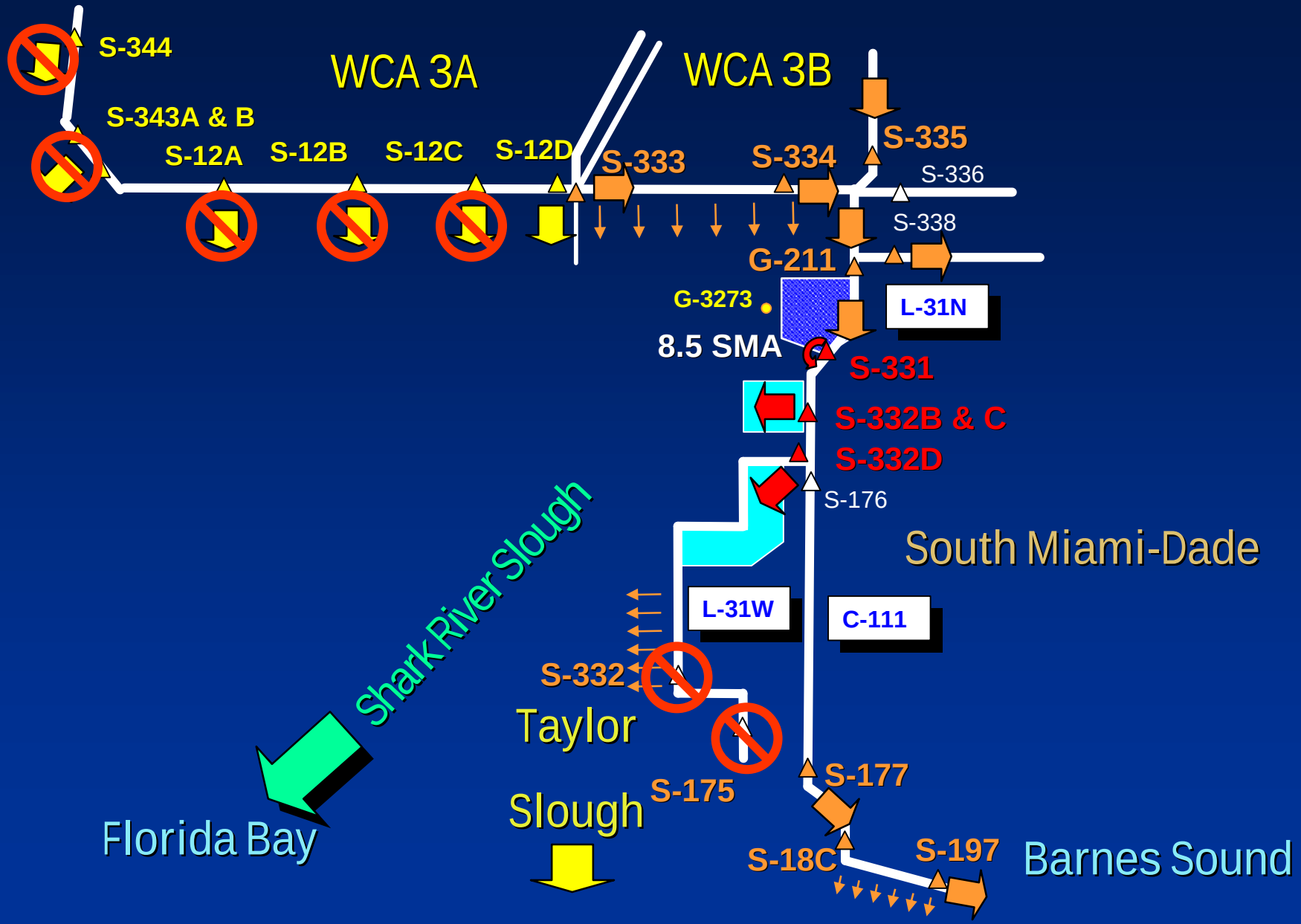
Wading Birds

Manatee

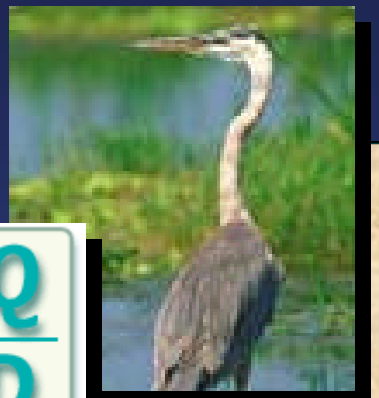
Crocodile

Cape Sable Seaside Sparrow Population Distribution

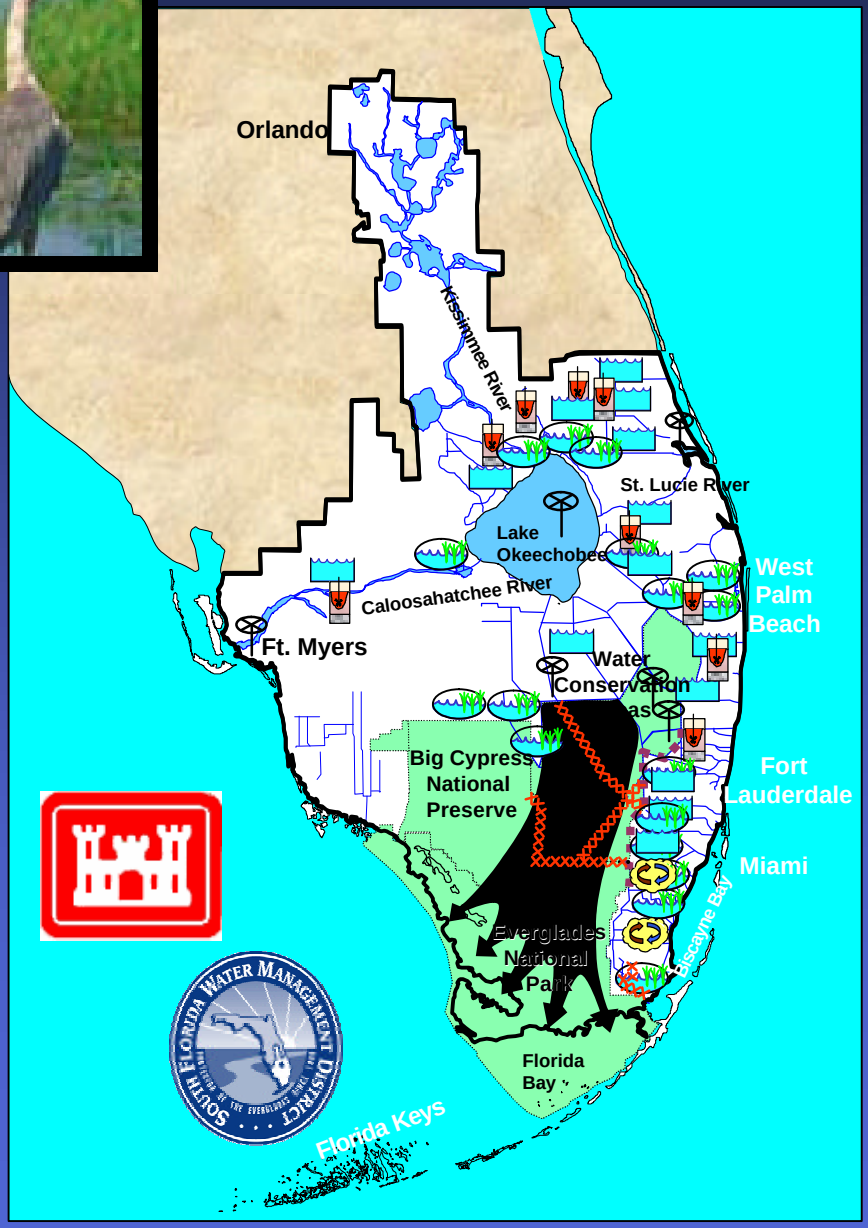
IOP - 2002


S-344
S-343A & B
WCA 3A
WCA 3B
S-12A
S-12B
S-12C
S-12D
S-333
S-334
S-335
S-336
S-338
G-211
G-3273
L-31N
8.5 SMA
S-331
S-332B & C
S-332D
S-176
South Miami-Dade
L-31W
C-111
S-332
Taylor
Slough
S-175
S-177
S-18C
S-197
Barnes Sound
Shark River Slough
Florida Bay

C.E.R.P.



- CERP is a framework and guide to restore, protect, and preserve the water resources of central and southern Florida.
- CERP is comprised of 68 major components, which are grouped into over 40 projects.
  - Physical Facilities
  - Land Acquisition
  - Operations & Maintenance

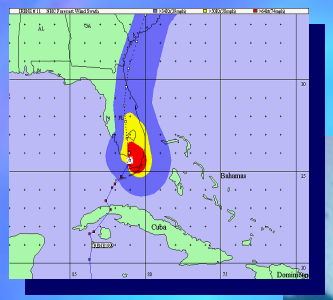


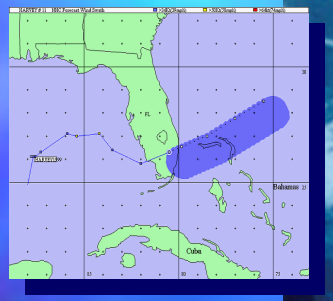
Drainage Operations

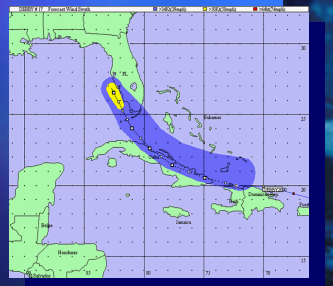
Typical Coastal Canal Operations: *Drainage*

- Runoff conveyed away from developed areas mitigate flood impacts
- Structure operations coordinated from District headquarters
  - Most critical structures remotely automated
  - Manual operations coordinated with local field stations

Tropical storms are frequent in South Florida





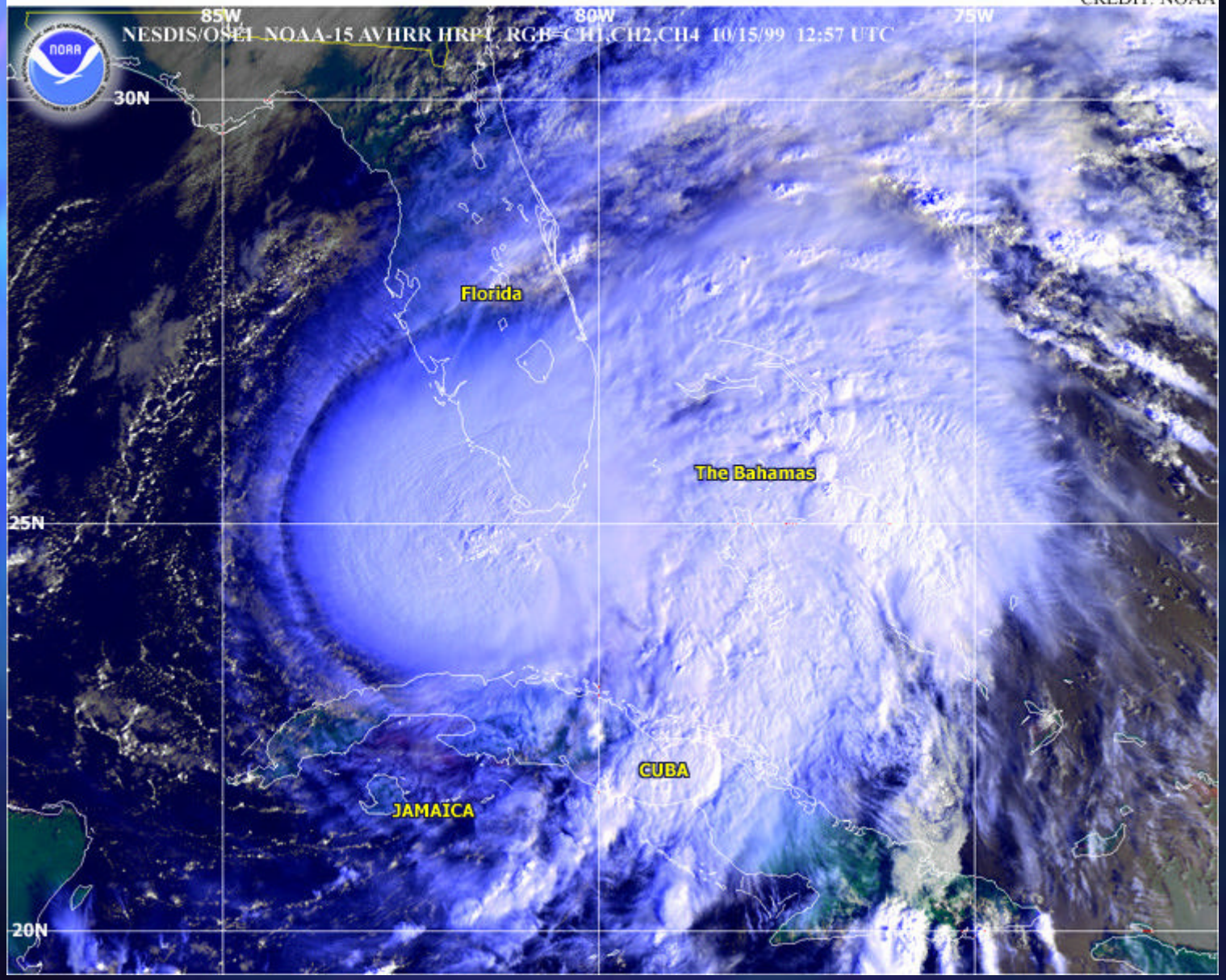


Hurricane season runs from June 1st through November 30th

JAN	FEB	MAR	APR
MAY	JUNE	JULY	AUG
SEP	OCT	NOV	DEC

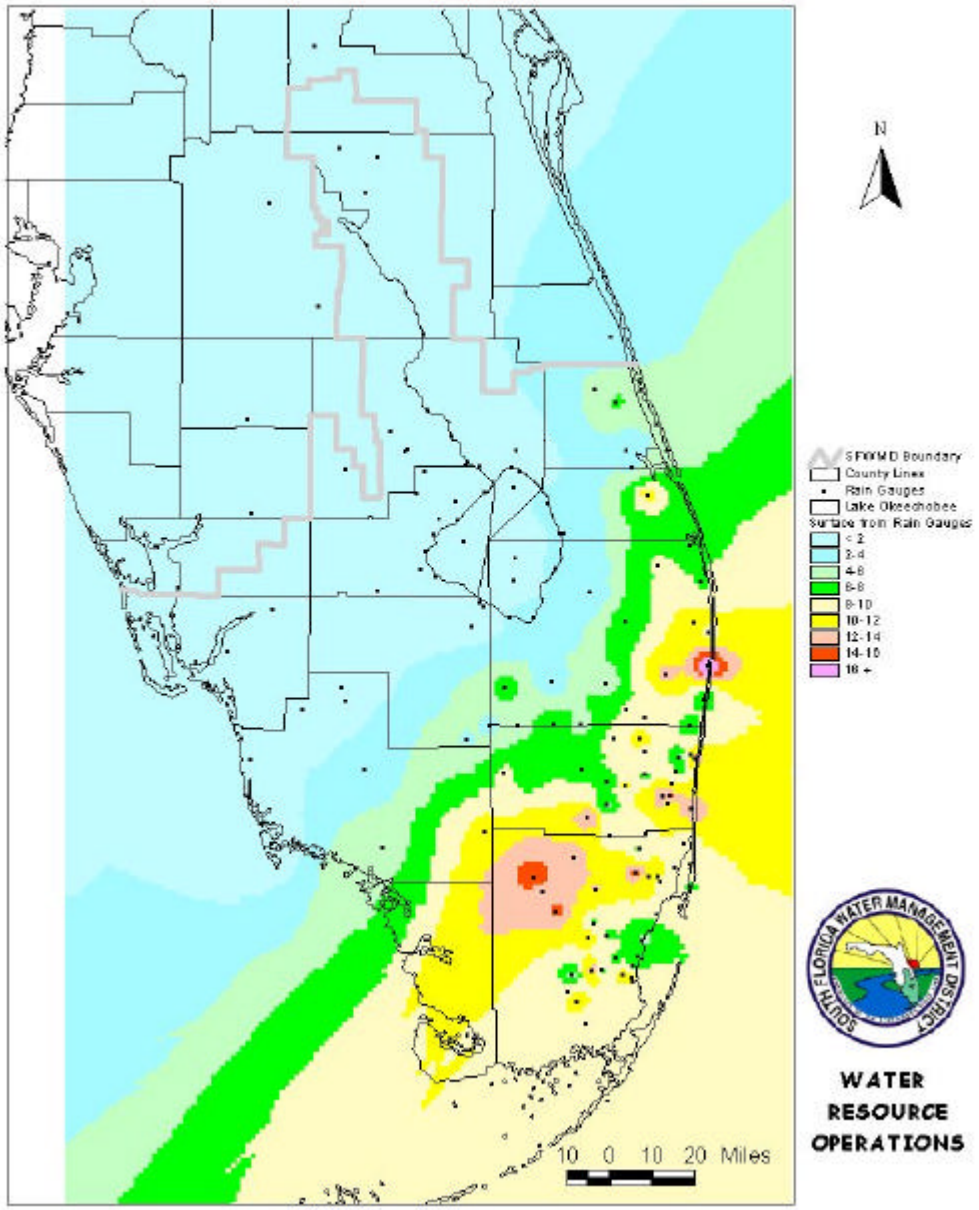
Hurricane Irene continues to move just east of due north over the Florida Keys with maximum sustained winds near the center at 65 knots (~75 MPH). Heavy rain is falling in many parts of south Florida as the storm approaches. A hurricane warning continues for the Florida Keys and portions of south Florida.

CREDIT: NOAA



RAINFALL DISTRIBUTION - HURRICANE IRENE

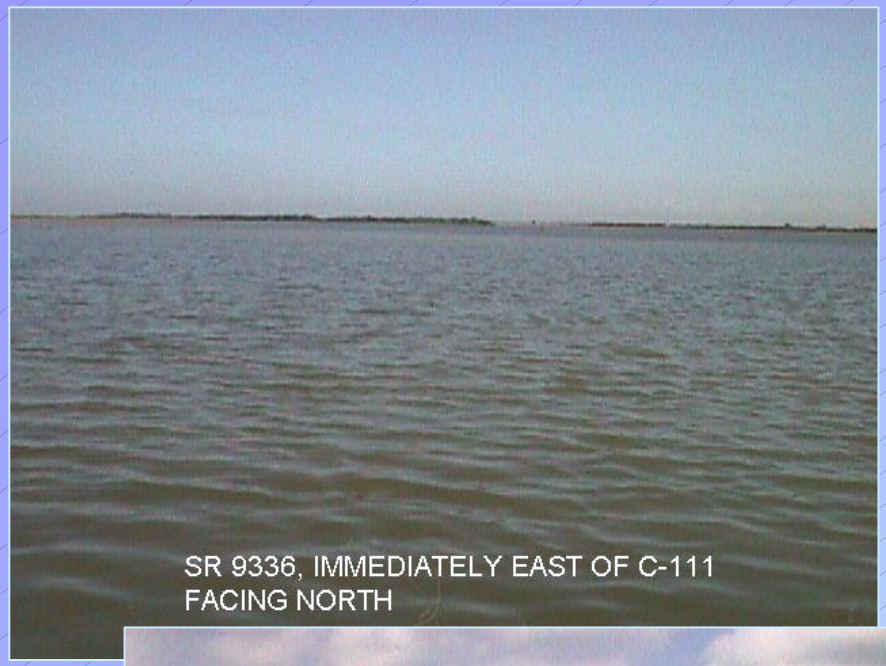
October 14 - 16, 1999

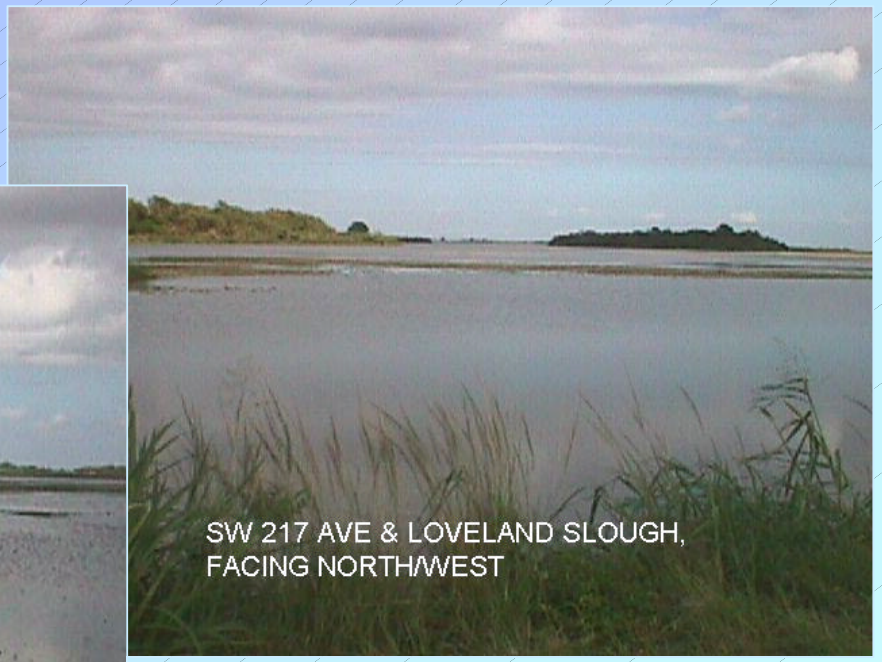


SOUTH FLORIDA WATER MANAGEMENT DISTRICT

WATER RESOURCE OPERATIONS

South Dade Ag Lands

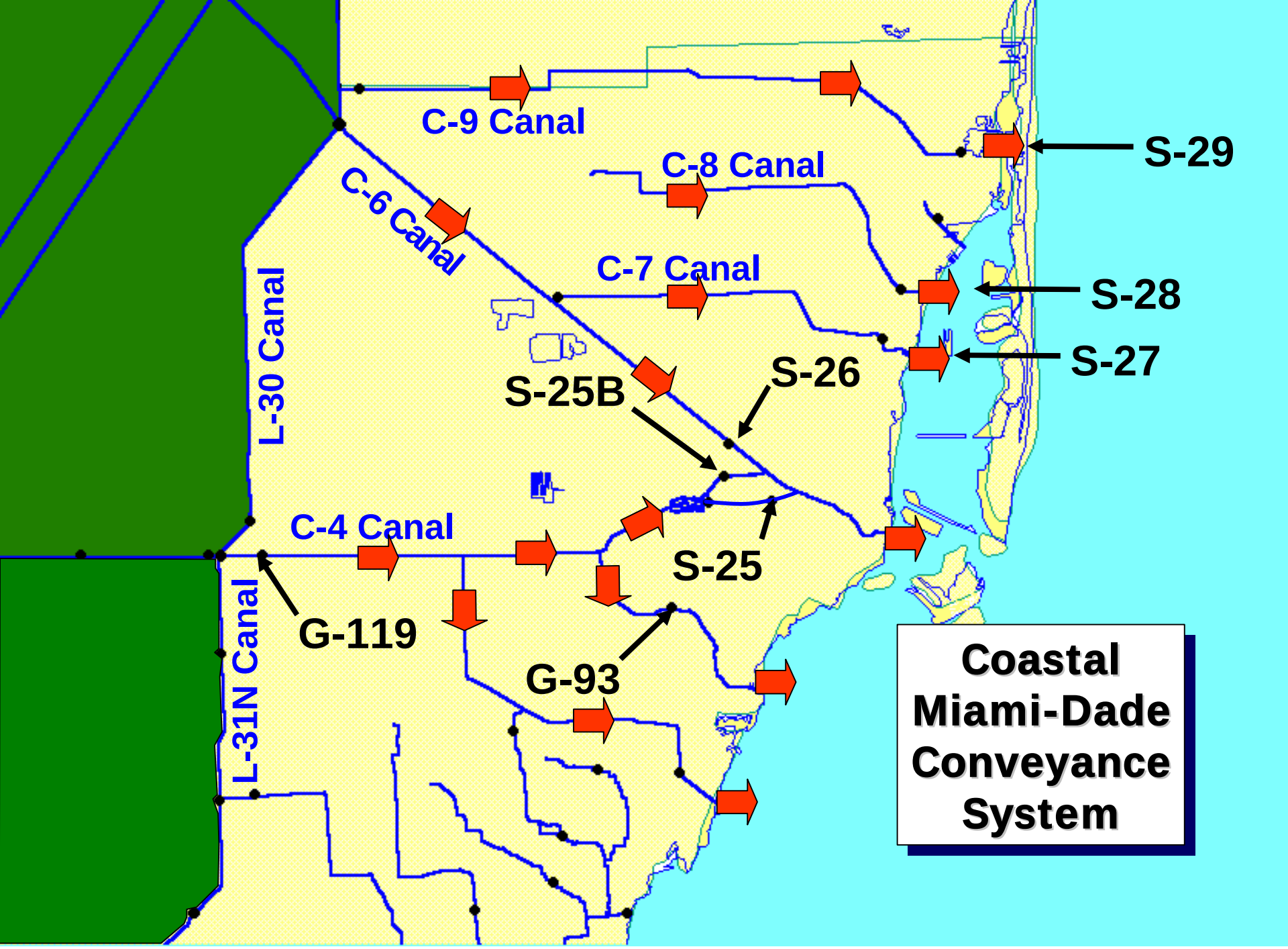




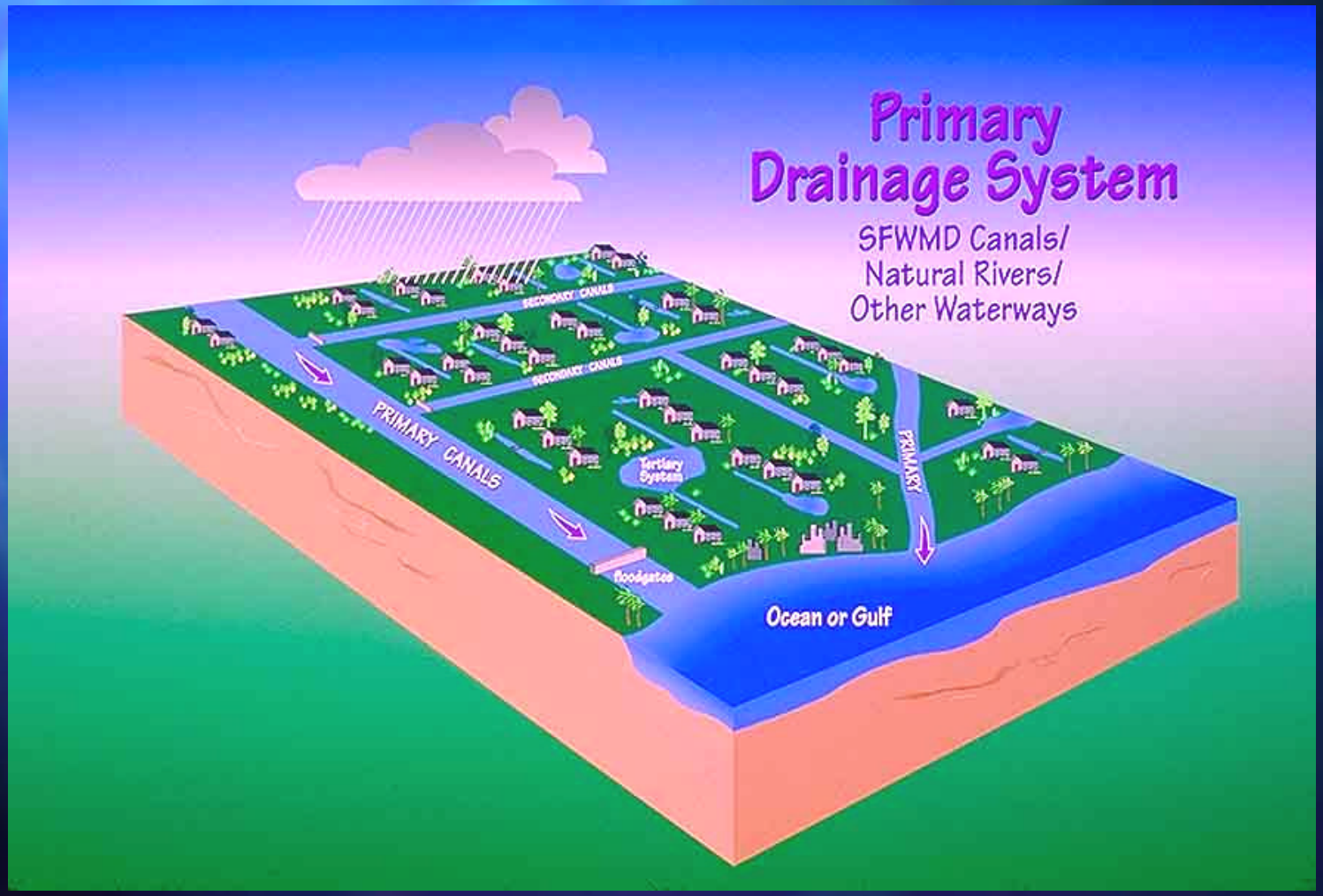
City of Sweetwater

City of West Miami


DANGER
GATES OPEN
WITHOUT
WARNING


C-9 Canal
C-8 Canal
C-6 Canal
C-7 Canal
L-30 Canal
S-29
S-28
S-27
S-26
S-25B
S-25
C-4 Canal
L-31N Canal
G-119
G-93
Coastal Miami-Dade Conveyance System

Drainage Responsibilities



Road Storm – 4 to 6 inches of rain in a 24-hour period. Standing water in yards, swales and ditches, but the crowns of roads should remain passable

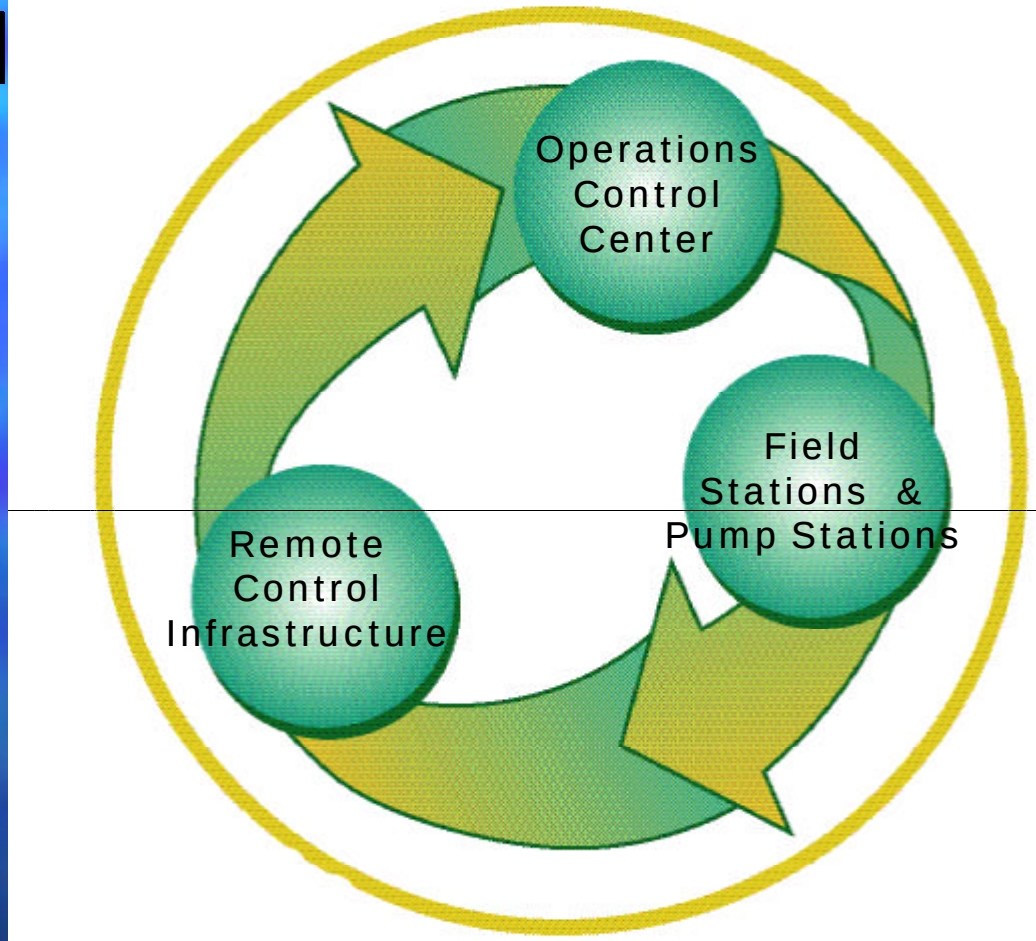
Design Storm – 7 to 10 inches of rain in a 72-hour period. Roads, as well as swales, ditches and yards flood, but buildings should remain dry

Hundred-Year Storm – 10 to 20 inches or more of rain in a 72-hour period. Many houses and businesses can be expected to flood

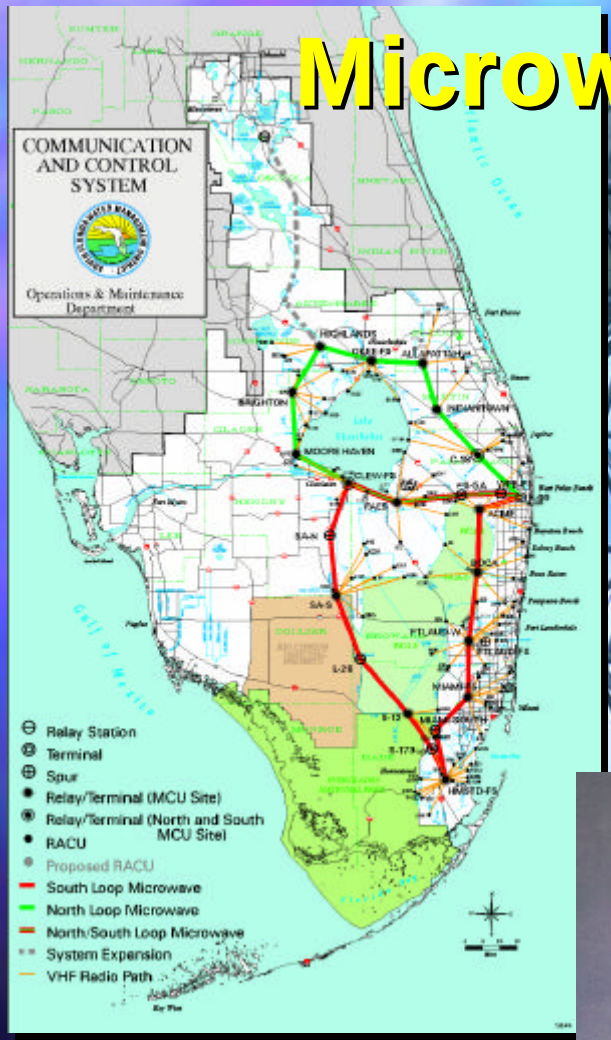
Primary Canal Operations

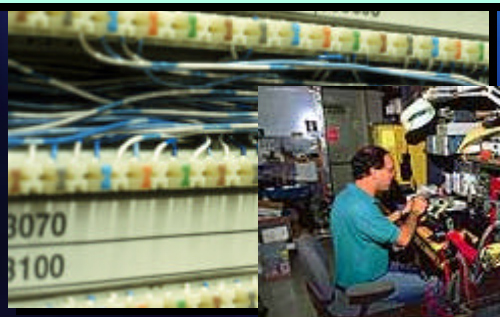
Primary Canal Operations

Basic Elements of the Flood Control System



Microwave Communication Backbone



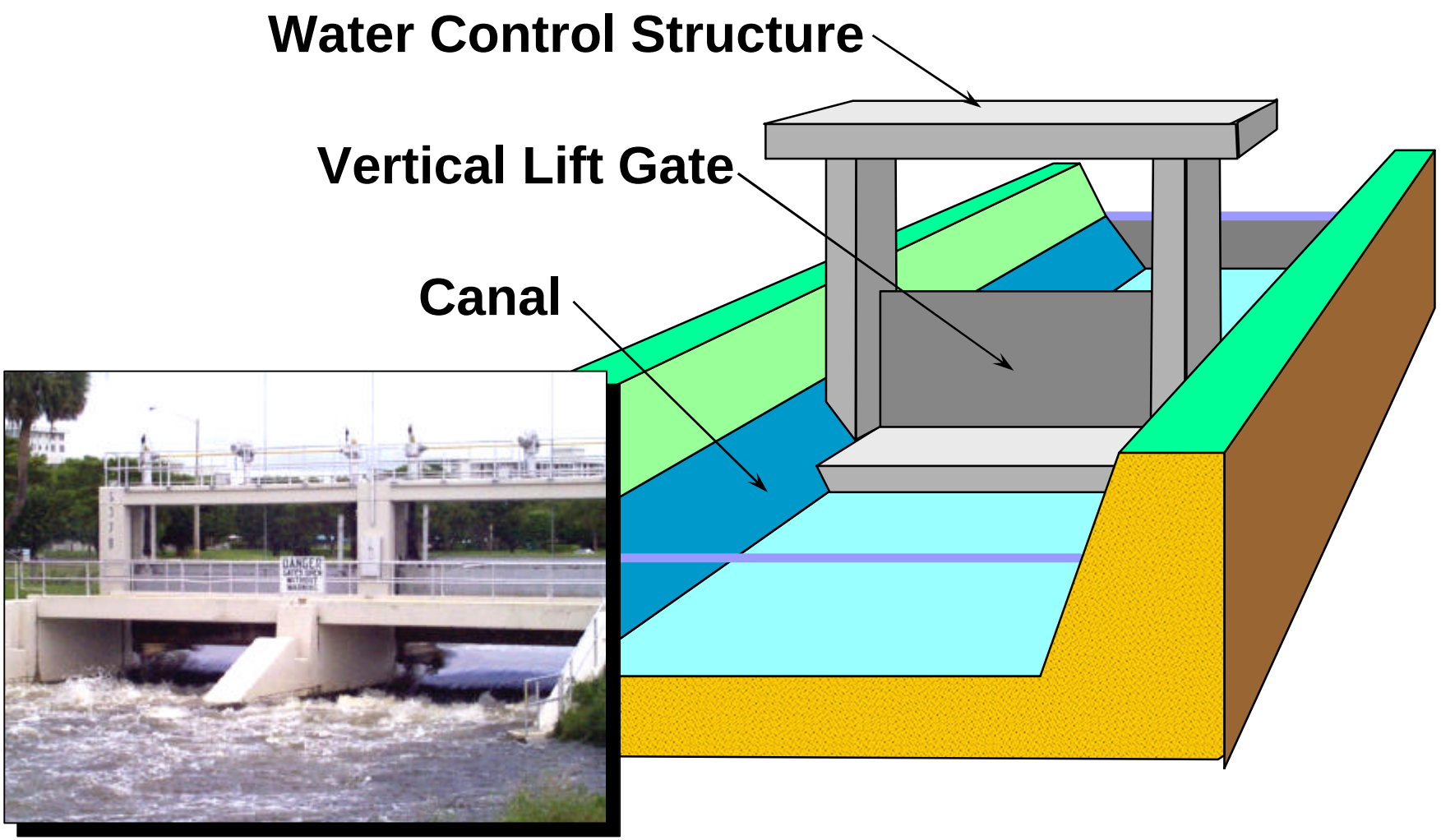


- Unique “wireless” communication system
  - Developed in early 1980’s
- Hurricane hardened
  - Dual-Loop redundancy
- Each tower communicates with a local “family” of structures
  - Communicates structure status every minute
  - Voice and computer network functions

Operations Control Center

- OCC coordinates water control activities
  - Structure Operations
  - Pump Stations
- Staffed 24 hrs per day, 365 days per year
  - Technicians
  - Meteorologists
  - Hydrologists
  - Programmers
- Serves as central dispatch to Field Stations

Gate Operations



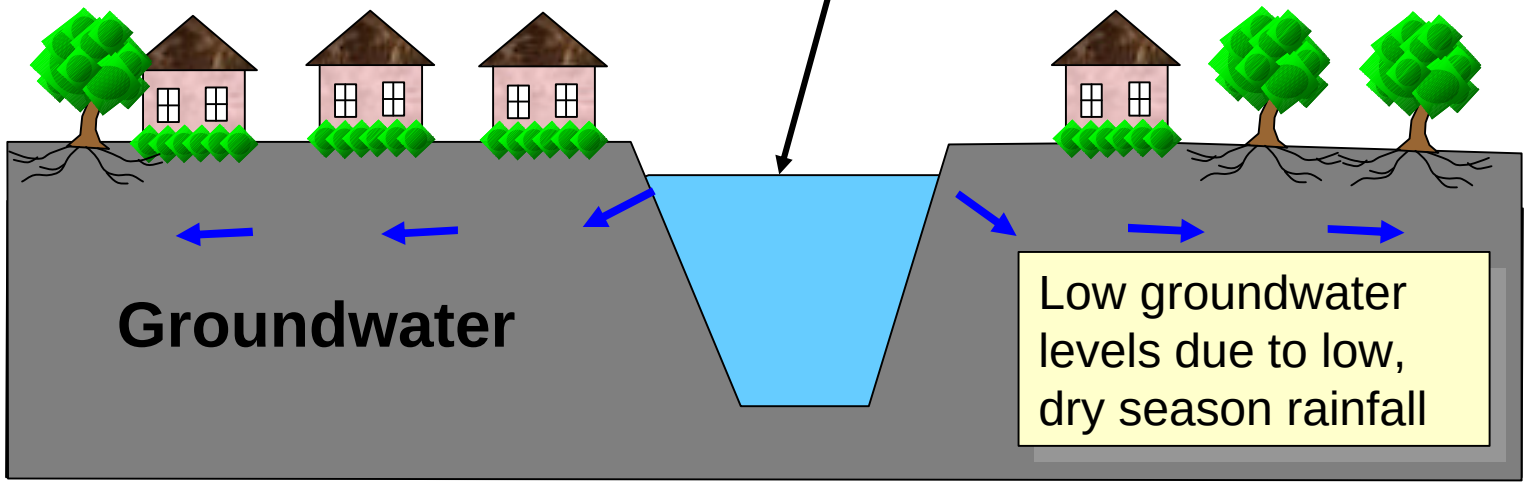
Canal / Groundwater Interaction

Normal Dry Season Operations

Canals serve two primary purposes….

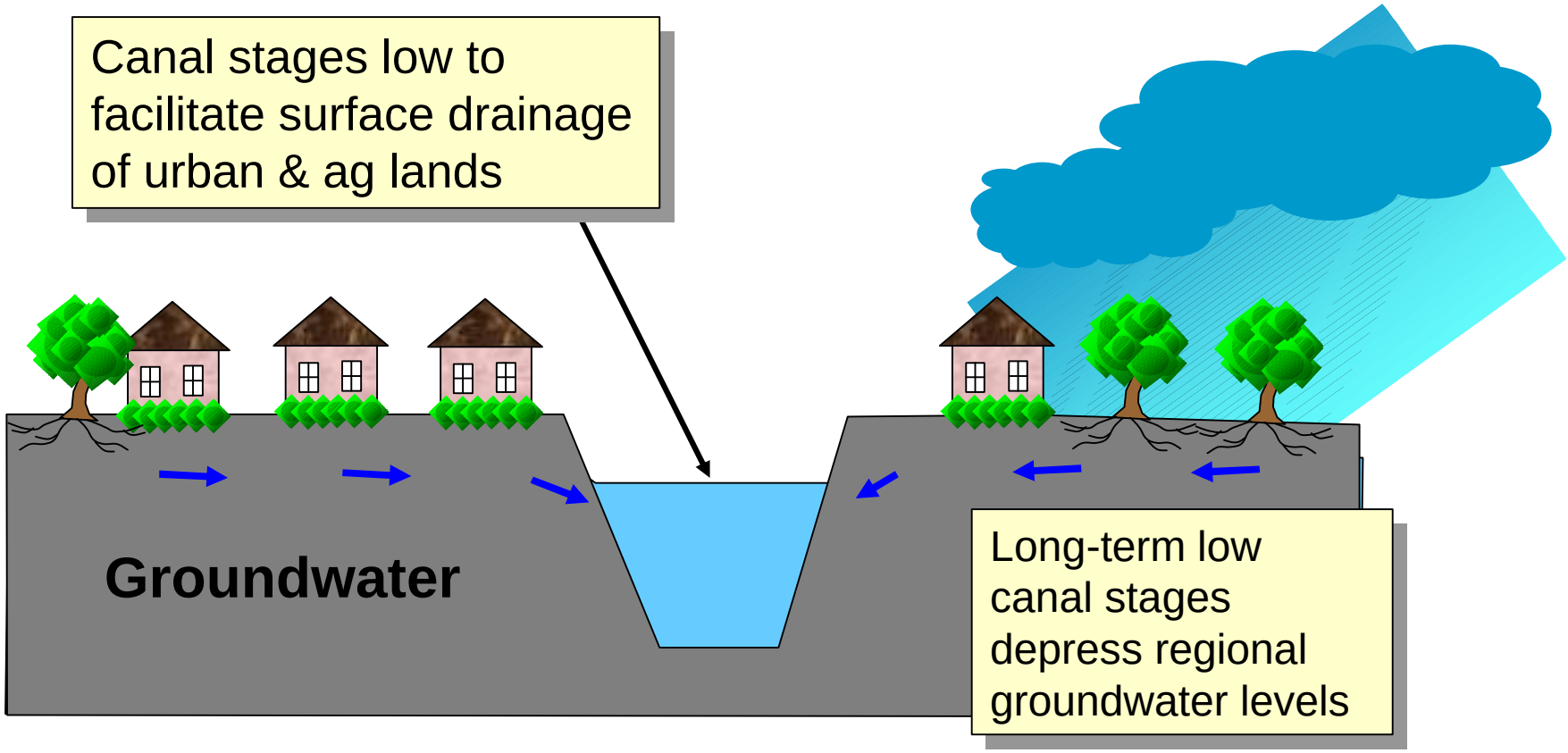
1. **Flood Control**
2. **Water Supply**

Canal stages held high to facilitate groundwater recharge and assist supplemental irrigation



Canal / Groundwater Interaction

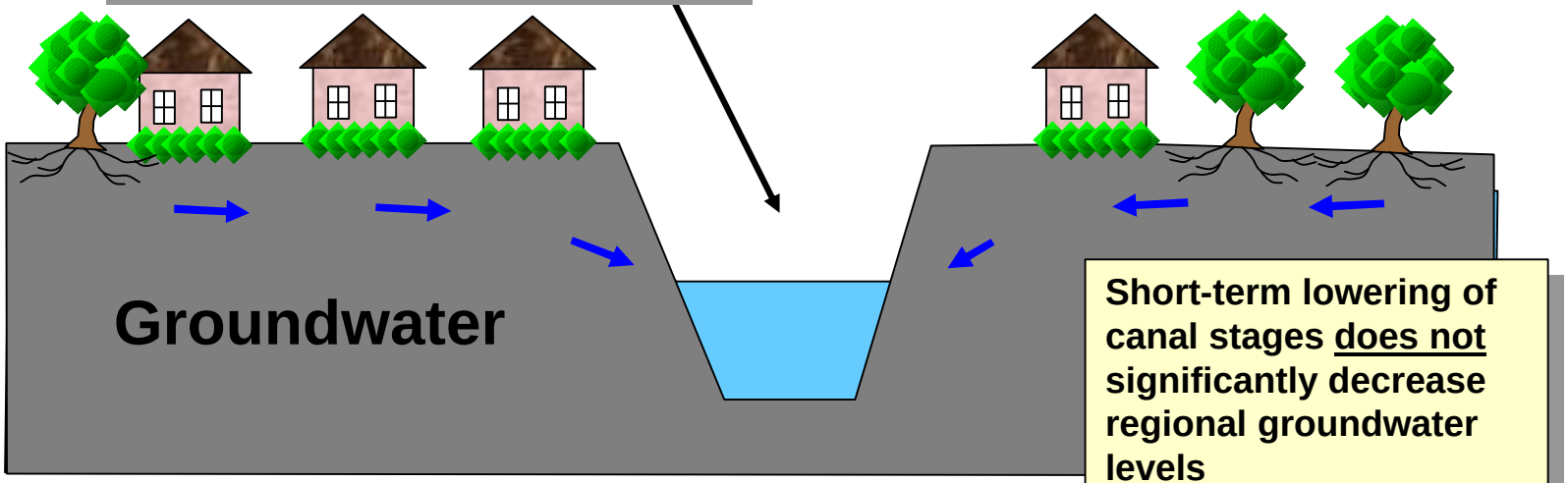
Normal Wet Season Operations



Canal / Groundwater Interaction

Pre-Storm Drawdown Operations

Canal stages lowered an additional ~1 foot to increase **surface drainage** of urban & ag lands prior forecasts storms

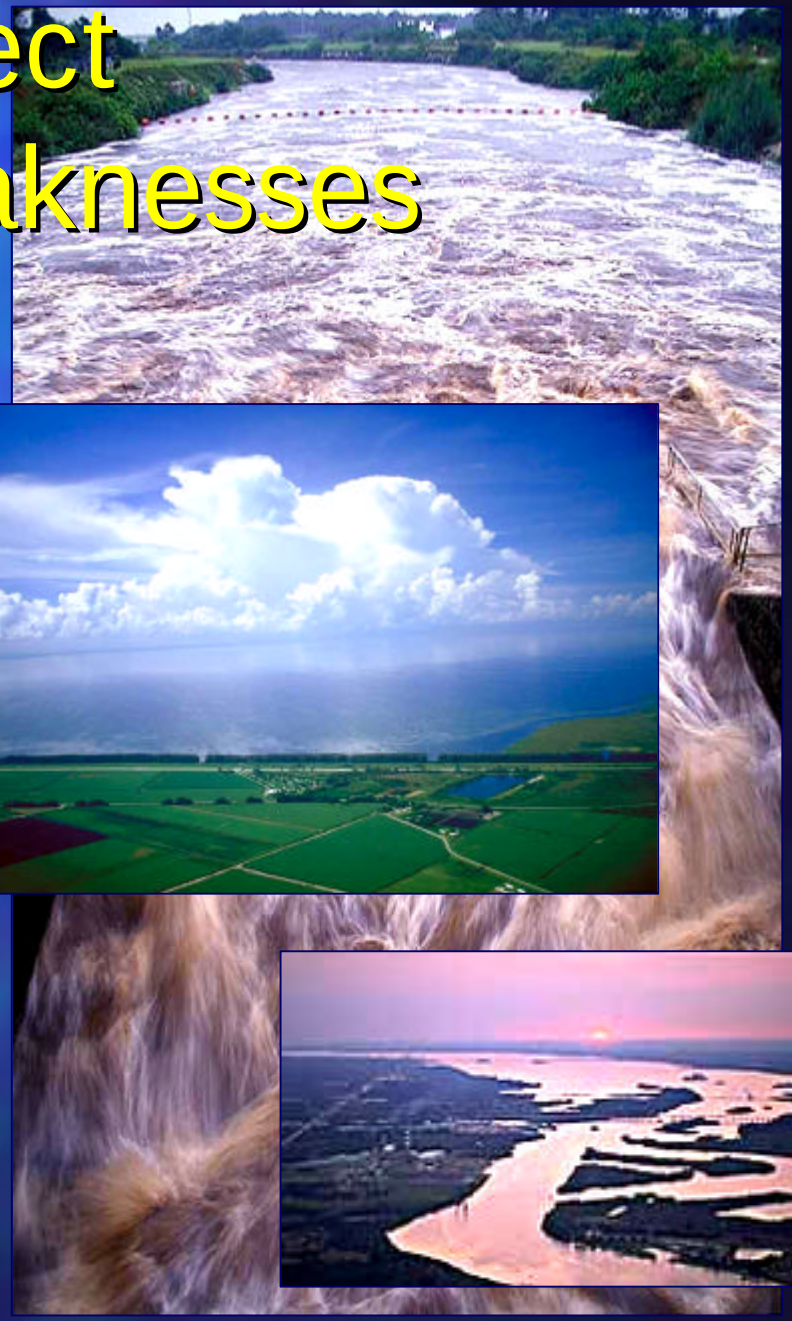


Short-term lowering of canal stages <u>does not</u> significantly decrease regional groundwater levels

Summary

C&SF Project Strengths & Weaknesses

- Provides significant benefits to developed areas
  - Flood control
  - Water supply
- Unintended ecological impacts associated with C&SF construction and operation



South Florida Water Resource Management

- Florida's climate is one of "extremes"
- System stressed by population & land use
- **BALANCE**
  - Multiple water reseource objectives
  - Objectives often conflict

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

sfwmd.gov